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ABSTRACT

The study examined the effect of two instructional interventions (equivalence training and functional object use training) as well as practice alone with 21 autistic children (3 to 16 years old) selected for their visual overselectivity. The study had four phases: 1) pretraining in which potential Ss were trained on matching to sample tasks, 2) pretesting which involved identifying those Ss who demonstrated visual overselectivity, 3) intervention, and 4) posttesting. The intervention phase involved having eight Ss receive an equivalence training program consisting of a four-step match to sample sequence, having another eight Ss participate in a functional object use program of training with pairs of objects, and providing five Ss with unreinforced practice on the pretest tasks. Analysis of individual subject data indicated that equivalence training was more effective than the functional object condition, with repeated practice falling about midway between. The report provides an executive summary and chapters covering an introduction to the study, review of the literature, methodology, results, and discussion. Eight appendixes include samples of the pretraining stimuli, sample configurations of test stimuli, a sketch of the instructional setting, sample data collection forms, the configurations of stimulus generalization probes, behavioral objectives and logical task analyses for three functional object use skills, flowcharts of experimental procedures, and task analyses of overselectivity computations. (DB)

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ED223059

A COMPARISON OF TWO INSTRUCTIONAL PROCEDURES FOR REMEDIATING ATTENTIONAL DEFICITS OF AUTISTIC SCHOOL-AGE CHILDERN OVERSELECTIVE IN THE VISUAL MODALITY

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Forward

At the time of the passage of Section 504 of the 1973 Rehab Act (and later PL 94-142 in 1975), special education too often seemed to be into what wasn't. The late 1960s and early 70s was a time of much pedantic bickering about watered down curricula, about the impact of labels on the labeled, the merits of a "borderline" category in definitions of retardation, of ill-conceived generalizations about the horrors of state-run institutions and inner city classrooms, of humanism vs. behaviorism, and even the issue of block grants or categorical aid for funding special education programs. The abiding issue, in truth, was more critical: Simply stated, the paramount concern on the part of many constituencies during the 1970s was how to attain and maintain desired changes in the asocial behaviors of handicapped individuals. That advances could be made with the handicapped was clear to most child advocates; but less clear was just how to ensure that the painstaking efforts required to bring about that change would be forthcoming. Few educators seemed prepared to address the issue.

On the front lines, then, apart from the dialogue and debate, precious little appeared to be happening in special education. Quietly, though, and hidden beneath the drone of a tiresome and repetitious literature, the groundwork for substantive change was being laid. A coalition of disaffected families, unassuming legal rights advocates, and sensitized educators was preparing to challenge a monolith which, without sanction or savy, continued to misdiagnose, misclassify, misplace, and misrepresent the handicapped youngsters it was to serve.

Amid the ineffective discussions that suffused national conventions, "hidden colleges," and scholarly publications during that era, it proved to be the courts and the legislatures rather than educators that, at last resort, were called upon to redress the wrongs being inflicted upon the handicapped. And through such efforts, the hegemony of a callous educational system had at last become the issue.

Looking back now, the litany of decrees and regulations legal remedies provoked did indeed lead to some improvements in the quality of educational care provided to handicapped children and adults. The cost of that court-induced change, however, appears increasingly to have been high. For lost in all the clamor over IEPs, for example, was the relevance of a diagnostic/prescriptive tradition which PL 94-142 simply encompassed and legitimized. Rather than being understood as a refinement of the ubiquitous lesson plan, the IEP early on was perceived not as a facilitating management tool which was its purpose, but as an accountability weapon to be opposed at every turn. As one official put it, the IEP become something to swear at rather than swear by. An even more disturbing result of this pre-occupation with issues secondary to "zero-inference" instruction has only recently emerged. Over the years, it seems, there has been a gradual blurring of just what the major objectives of schooling should be. There is apparent confusion about what the central mission of education is all about.

If this preliminary outline of the sociology of PL 94-142 is useful, then even more so is the challenge John Dewey offered in the early 1930s: "Let Each Become All (S)he is Capable of Being," was his plea. Many years later, of course, Jerome Bruner added that, "Any

subject can be taught in an intellectually honest form to any child at any stage of development." Both reflect what we now take as an article of faith -- that as educators, it is our desire and demand to make our pupils each day a bit more self-reliant, a little more free to do for themselves what yesterday required the assistance of others.

Increasingly, however, in a litigious climate, schooling for the handicapped has been less concerned with becoming and more preoccupied with issues of educational malpractice, with credentials and teaching licenses, with protections against accountability checks, and with a whole host of concerns quite aside from creating effective schools and quality instruction. Unless we again begin to find strength in the values which Dewey and Bruner embody, history may find that the past decade of change, for special education at least, proved to be little more than a ten-year conversation. And rhetoric alone, as we have discovered, accomplishes precious little.

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12/1/81

Preface

Discrimination learning theory has become more sophisticated (or arcane) over the years, particularly in its terminology and research methodology. Traditional conceptions once broke the theory into two general experimental paradigms, those of successive discrimination and simultaneous discrimination. Later, the formation of discriminations was viewed from such perspectives as operant/instrumental conditioning, respondent/classical conditioning, and observational learning. Still later, terms like errorless learning, secondary conditioning, delayed conditioning, and temporal conditioning found their way into the literature, each with its clearly articulated raison d'etre. Presently, one can argue rather elaborately that discrimination may better be conceptualized as a measure of stimulus control, marked by the slopes of its generalization gradients.

Within such a context, this monograph moves into yet another area of discrimination learning. Linking discrimination (or stimulus control) to the research on perception and to the development of selective attention, recent studies have uncovered a rather peculiar learning handicap. In short, numerous investigators have found that some children (generally those who are perceptually handicapped, but also very young normal children as well) exhibit a curious pattern of inappropriate selective attention when faced with simple two-choice discrimination or match-to-sample tasks. Such children tend to lock onto, become hooked to, or otherwise respond to stimulus cues which are irrelevant to the correct completion of a task. The highly atypical error patterns which

these children tend to exhibit gave birth to an area of discrimination research which Lovaas and his colleagues labeled stimulus overselectivity.

The three-year project reported in this monograph studied strategies for assessing and remediating overselectivity. Specifically, the focus was on visual overselectivity and the emphasis throughout was to provide replicable procedures of all experimental phases so that others could improve on the design, interventions, and practical benefits the work might offer.

Ordinarily, the research project conceived, proposed, and funded generally does not prove to be the research actually conducted--protestations to the contrary. In this study, changes were made in the original design and in implementing the original proposal; however, the changes proved to be minor and all were related to time constraints and restricted subject pools.

For example, originally there were to be five tasks involved in training and testing subjects. Along with the spoon/bowl, foot/shoe, and crayon/drawing paper stimuli, the project anticipated using tissue/tissue box and basketball/basketball net stimuli. However, the pretraining and prescreening (pretesting) phases of the project took far longer than expected. As a result, the latter two stimulus sets were used as stimulus generalization probes rather than as part of the testing phase.

In addition, the project planned to involve at least fifteen subjects for each of the three experimental conditions (equivalence

training, functional object-use, repeated practice). But, securing sufficient numbers of subjects presented another problem: A decision had to be made as to whether to accent diagnostic purity in terms of defining overselectivity or to focus on maximizing sample sizes for purposes of generalization. If the operational definitions of overselectivity were relaxed, the sample size, we discovered, could meet our target of 45 subjects (15 subjects per condition). At the same time, given the nature of the question we were investigating--namely, the impact of two robust interventions on a discrimination handicap--rigor of definition was important, if only to improve the validity of the findings. We thus opted for rigor rather than for generalization and were able to locate only 21 subjects from a total pool of some 150 children labeled as autistic. That change alone forced us to alter our original design and interpretation phases of the study.

Finally, the timelines for the study changed. It was anticipated that the work could be begun and finished in about a year. Not surprisingly, however, the ambitious nature of the study resulted in nearly two years of ongoing on-site research activity. The delay had something to do with the typical scheduling problems one encounters when working with school-based subjects, but it also had a lot to do with the difficulty in accurately projecting start and finish dates for the various phases of research projects in general.

Be that as it may, the time is rapidly approaching when such concerns can and will in all probability be remedied quite readily. Timelines will be reduced, client protection rights more tightly monitored, data results more quickly analyzed, and implications of

findings far more thoroughly integrated with existing literature. The source of this optimism is the almost unbelievable growth and development in microcomputer technology and the information networks which the system has fathered. Researchers across the country already are making ever-greater use of a growing number of computerized databases which are springing up on both coasts. Those databases (e.g., SpecialNet) open up opportunities for researchers and teachers alike to update and upgrade their information on scores of topics immediately relevant to special education and psychology. With the newfound speed and availability of the very latest information, there can be far less duplication of effort, a much better understanding of what others are doing, a greater likelihood that research activity from around the country will be integrated and bolted onto a common core of problems, and an improved chance that tomorrow's research will more tightly reflect, refine, and extend the work of today.

Finally, as with any endeavor undertaken in earnest, the success of this project was in a significant way a product of the time and commitment of several individuals who deserve recognition. Foremost, special appreciation is expressed to Dr. Crighton Newsom who at the time of the study was Research Director, Smithtown Child Development Center, Smithtown, Long Island. His enthusiasm, technical expertise, gracious support, and tireless efforts during all aspects of the study proved truly indispensable. The author also is deeply indebted to Ms. Judy Lawrence, a doctoral student at Columbia University, who assisted generously in the critical data collection and data analysis phases of the research. Much credit also is due to the administration and staff

of the Suffolk Child Development Center for their cooperation and assistance in the collection of the data herein reported.

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Executive Summary

Recent litigation and legislation have combined to ensure that the handicapped are granted their implied constitutional right to a free, publicly supported education in the least restrictive instructional setting available. However, more recent events suggest clearly that federal or state mandates alone will not ensure that instruction for the handicapped will either be appropriate or effective. If the handicapped are to be successful in making the transition from institutional settings to public school classrooms, then those on the front lines of the movement will have to be provided with the requisite programmatic support necessary to meet the intent and the spirit of IEPs and the diagnostic-prescriptive model upon which "appropriate" education is based.

Accordingly, this study investigated the effect of two instructional interventions on a learning handicap that has been identified in many autistic pupils who are entering public school classrooms. The handicap, known as stimulus overselectivity, prohibits the pupil from attending to all the relevant aspects of a task. The result is a pattern of incorrect responding which often retards the pupil's ability to succeed in the type of learning activities which typify primary-level public school education.

The study consisted of four phases: (1) Pretraining — Fifty-seven pupils clinically diagnosed as autistic were initially pretrained on 3

matching-to-sample tasks. (2) Pretesting — The 54 who were able to acquire criterion level pretraining task within 300 trials were then pretested on 3 separate tasks for the presence of visual overselectivity. (3) Intervention — The 21 candidates who met the dual screening criteria used to define visual overselectivity were randomly assigned to one of the following three experimental conditions: (a) Eight subjects participated in an an equivalence-training program which consisted of a four-step match-to-sample sequence (matching objects to objects, objects to photographs, photos to photos, and photos to colored line drawings). (b) Another 8 subjects participated in a functional object-use program in which each was trained to use three sets of commonplace materials (spoon/bowl, foot/shoe, crayon/drawing paper) in a functionally appropriate manner. (c) A third group of 5 autistic pupils served as the comparison sample for the study and were exposed to a series of unreinforced trials on the pretest task materials in order to test the hypothesis that repeated practice alone might reduce overselectivity. (4) Posttesting — All 21 subjects were re-tested, using tasks, materials, and procedures identical to those in effect during pretesting. In addition, as part of the posttest phase, stimulus generalization probes were run with subjects who most improved on the posttest measure.

Analysis of individual subject data showed clearly that equivalence training was more effective than the functional-object condition, with repeated practice falling about midway between. Ancillary findings revealed: (1) No relationship between IQ or CA and posttest score or performance gain was detected. Hence, individual performance was not

related to either intelligence (IQ) or age (CA). (2) All subjects who were able to acquire the pretraining match-to-sample criterion response did so within 15 trials. Moreover, all subjects who succeeded in learning the criterion pretraining response maintained an almost perfect level of correct match-to-sample behavior on subsequent training trials. (3) No "learning-to-learn" acquisition curve across trials was detected. That is, analysis of individual responding patterns did not reveal a tendency to do better on later test trials. (4) All subjects were able to acquire within 5 trials the conditional discrimination most frequently missed during testing. (5) No significant position preference patterns were uncovered. (6) There was some evidence of a stimulus preference bias among some subjects on one of the three tasks. (7) No subjects were lost over the the course of the study. (8) Finally, no evidence emerged to suggest that subjects at one site performed any better on the pretest or posttest than subjects at the second site.

The results of the study were further analyzed in terms of a number of potential experimental confounds, including: (a) purity of the "autism" diagnosis; (b) definitional rigor of the "overselectivity" criterion selected; (c) modality within which the handicap occurs (e.g., visual, auditory, etc.); (d) severity of the overselectivity handicap; (e) number of test tasks employed; (f) number of cues comprising the task stimuli; (g) type (equivalence vs. object manipulation vs. repeated practice) of treatment selected; (h) number of training trials allowed during intervention; (i) learning history and learning style of subjects involved in a given condition; and (j) type of reinforcement menu used. Given the complexity of these (and other) possible interactions, it was

suggested that future research begin to examine such variables, if applied overselectivity research is to prove of practical benefit in classroom settings.

Finally, the study was discussed in terms of implications for classroom teachers confronted with the handicap. Generally, it was argued that teachers can benefit from the detailed operational procedures set forth for devising traditional lesson plans. Specifically, the study provided sample behavioral objectives, instructional materials, training procedures, and motivational strategies for programming object perception through discrimination and matching-to-sample classroom activities. Elaborate flowcharts, data forms, and measurement criteria were included as guides for implementing the instructional system as designed in the study.

The study concluded on a note of optimism: If programmatic guidelines such as those contained in the study are made available to teachers on the front lines of PL 94-142, then perhaps IEPs will be received with greater enthusiasm. Moreover, with increased attention to systematic programming and the positive results that may thus accrue, the Bruner ideal of teaching most skills to most (handicapped) individuals may yet come to bear.

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Chapter 1

INTRODUCTION

Purpose and Scope

> The specialization of science is an inevitable accompaniment of progress; yet it is full of dangers, and it is cruelly wasteful, since so much that is beautiful and enlightening is cut off from most of the world. Thus it is proper to the role of the scientist that he not merely find new truth and communicate it to his fellows, but that he teach, that he try to bring the most honest and intelligible account of new knowledge to all who would try to learn.
>
> (Robert Oppenheimer, 1955
> quoted in Bennis et al., 1976, p. 3)

Oppenheimer states eloquently what may be taken as the central impetus for this study: How can promising empirical outcomes of science be translated more effectively into instructional practice? The question bears directly on the "theory-into-practice" gulf that continues to separate experimental science from the practical arena of everyday problem-solving (Berman & McLaughlin, 1976; Campbell, 1969; Mann, 1977; Pincus, 1974, Rosenshine & Martin, 1974). From many quarters, educators are raising questions about the quality of instruction in the school. Bettelheim (in Hall, 1971), for instance, recently completed a study of what goes on in primary school classrooms; his conclusion: "Our children are treated like idiots." Lawrence Cremin (in Hechinger, 1981), President of Teachers College/Columbia University, addressing the issue of declining quality of the nation's teacher training programs, was quoted in an interview as remarking that those programs "need drastic revision...(that) many schools of education haven't faced up to what's

happening in society" (p. C4). Turning to special education, Cruickshank has been similarly direct in his criticism of teacher preparation. "Teacher education and the field of special education do not," Cruickshank contends, "warrant the (elevated) status they have." He continues, "I would change teacher education....I would substitute superficial gibberish with content" (Markel, 1980, p. 18).

Plainly, schools continue to be under attack for their perceived shortcomings (Newsweek, 1981). Geis (1970) among others has called for greater cooperation between research and practice, admitting that the "gap between laboratory and classroom cannot be bridged (any longer) by talk" (p. 379). What is needed is an increased commitment to the design and use of "more 'functional' educational strategies" for solving the practical problems facing classroom teachers (Wiemann & Backlund, 1980, p. 185). In light of the many added responsibilities which recent legislation and litigation have brought to teachers of the handicapped, it may thus be timely once again to consider the implication of Oppenheimer's wisdom: How can the conditions of learning, principles of teaching, and rules of instruction be applied more effectively to contemporary instructional practice?

Within this context, the present study will compare the effectiveness of two classroom interventions for remediating a specific learning handicap often exhibited by autistic pupils. This handicap, known as visual overselectivity, severely restricts the ability of such children to attend to complex input -- to the multiple cues typically associated with such elementary classroom tasks as discrimination training and matching-to-sample activities. Given the importance of

attention to successful task completion and to effective instruction generally, the press to identify and evaluate practical approaches to overcoming such a learning handicap is urgent, and perhaps now more than ever.

Public Policy and PL 94-142

> Change in legal standards, whatever its source, does not insure altered school behavior.
>
> (Kirp et al., 1974, pp. 112-113)

A prominent characteristic of American public schooling in recent years has been its preoccupation with educational innovation. "In the rush toward social reform of the early sixties," Madaus et al. (1980) have commented, "the belief was widespread that schooling could make a major contribution to the attainment of equality of educational opportunity for all citizens..." (p. xi). Of late, however, that article of faith has been under severe strain. In Gilhool's words, "litigation is busting out all over" (1973, p. 597). Judicial mandates and legislative enactments of the 1970s--culminating as they have in the passage of PL 94-142--both reflect and underscore a greater resolve to pursue such hotly debated movements as least restrictive placement (Ellis et al., 1981; Ferleger & Boyd, 1979; Landesman-Dwyer, 1981; Menolascino & McGee, 1981; Vail, 1966), competency-based instruction (Blackhurst, 1977; Ebel, 1978; Pipho, 1978; Resnick, 1980), teacher accountability (Gephart, 1975; Lessinger, 1970; Turnbull, 1976), due process requirements (Abeson et al., 1976; Budoff et al., 1976; Scandary, 1981), and educational malpractice options (Connors, 1981;

Dunn et al., 1977; Levenson & Spillane, 1977; Meyen & Altman, 1973; Patterson, 1980; Rich, 1976; Univ of Pa. Law Review, 1976).[1] These developments among others have forged fundamental changes in the delivery of instructional services to the handicapped -- changes, for example, in organizational patterns, in administrative responsibilities, in curriculum design, and in parental expectations (Hobbs, 1975; Hobbs et al., 1979; Weatherley, 1979; Weintraub et al., 1976). But more significantly, perhaps, these trends also have helped redefine teacher roles and revamp educational practice to an extent unanticipated even a short ten years ago (Cohen, 1970; Kauffman & Hallahan, 1981; cf. Tom, 1980; Wise, 1979).

On many fronts and in numerous ways, then, special education is in uneasy flux. Taxpayers and government agencies alike are wondering if schools really are effective, particularly as they now strive to meet the needs of the handicapped. Consequently, "Congress and the public are asking educators to be accountable, to show the public that they (the Congress and the public) are getting a 'bang for their buck'" (Cook, 1972, p. 2). The passage of PL 94-142 and the requirement of an Individualized Education Program (IEP) for each handicapped pupil has been, it might be argued, a partial response to a continuing search for

---

[1] Bateman and Herr (1981) present a thorough yet nontechnical review of these issues. One conclusion they draw from their analysis of the accountability movement is that special educators might well obtain legal training as part of their professional preparation (p. 352). In the case of malpractice or negligence suits, for example, the authors predict that the following educational practices may be challenged in the future: "social promotions, the use of ineffective materials, mistaken diagnoses, identifying special needs but not providing a program for them...." (p. 350)

ways in which schools can be made more effective, more efficient, and more fiscally responsive (Berliner, 1979; Edmonds, 1979; Mann & Lawrence, 1981; Walberg, 1979).

Viewed in this light, perhaps it was not surprising that the passage of PL 94-142 was heralded with such early fanfare as a "Bill of Rights for the Handicapped" (Goodman, 1976), "revolutionary legislation" (Aquilina, 1976), and as an indication that the "quiet revolution" on behalf of the handicapped which Dimond (1973) so eloquently had chronicled was to end on "the opening day of school in September, 1978" (Abeson & Zettel, 1977).[2] Yet lessons gleaned from past federal activities in education (e.g., Halperin & Kaplan, 1976; Kerr, 1976; Radin, 1977; Rivlin & Timpane, 1976; Wise, 1979) suggested, however, that in truth PL 94-142 was to stand more as a statement of civil rights than as a bill of rights, more a process of evolution than the product of revolution. Given recent White House proposals to curtail and/or consolidate more than fifty federally funded programs in education (viz., Omnibus Budget Clarification Act of 1981)—proposals which could trigger more stringent accountability plans and competency demands as federal dollars dwindle—the responsibility for assuring the civil

---

[2]While admittedly important, a review of the historical events leading up to PL 94-142 (and Section 504 of the 1973 Rehabilitation Act) is beyond the scope of this discussion. For such a review, the reader is referred to the following sources: Abeson and Zettel, 1977; Amicus, 1977; Ballard and Zettel, 1977; Bateman and Herr, 1981; Budoff, 1975; Burgdorf, 1980; Dimond, 1973; Goodman, 1976; Harvard Law Review, 1977; Herr, 1972; Kirp, 1974; Kirp et al., 1974; Kleinfield, 1977; Mental Health Law Project, 1973; Office of Special Education, 1980c; Patton, 1976; Rodham, 1973; Roos, 1972; Semmel and Heinmiller, 1977; Turnbull and Turnbull, 1979; Wexler, 1973; Wolfensberger, 1975; Yale Law Journal, 1975; Zettel and Ballard, 1979. The Bateman and Herr chapter is particularly recommended.

rights of this "hidden minority" of learning handicapped pupils may, in the near future, come to rest largely with the classroom teacher and other concerned local-level personnel (Education of the Handicapped Newsletter, 1981).

The IEP: Is It Working?

> No matter what sort of bill you have, everything depends upon the men who, so to speak, are inside of it, and who are able to make it work. In the hands of the right men, any bill would produce the desired results.
>
> (Charles Adams, Jr. Director of the Union Pacific Railway, March 1, 1884, quoted in Fullan and Pomfret, 1977, p. 335)

The IEP is the cornerstone of PL 94-142. The Act calls for each child thought to be handicapped under the law to be individually diagnosed in order to ascertain whether or not (s)he will require special instruction (Ballard & Zettel, 1977).[3] Those children found to require special instruction are then entitled to an IEP.

Section 602 of the Act defines the IEP as a "written statement for each handicapped child...(that provides) specially designed instruction to meet the unique needs of handicapped children" (Ballard & Zettel, 1977, p. 179). The expressed purpose of the IEP is to function as a "management device" in order to "assure that, when a child requires special education, the special education designed for that child is

---

[3]It should be noted that children diagnosed as handicapped in accordance with federal regulation would not necessarily require special education services. Many can and do attend school without need of major program modification (see Ballard, 1977).

appropriate to his or her special learning need, and that the special education designed is actually delivered and monitored" (Ballard, 1977, p. 4). Much in the mold of diagnostic/prescriptive teaching (Bateman, 1967; Ysseldyke & Salvia, 1974), it is the IEP which defines the goals, objectives, and measurement criteria that guide individualized instruction.[4] Indeed, particular components of the IEP—multiple assessment, behavioral terminology, precisely delineated instructional goals, periodic program evaluation—combine to ensure that the mechanisms in fact are in place for implementing IEPs as required. In sum, IEPs reflect good instructional practice as much as mandatory compliance with PL 94-142.

The IEP: Compliance Problems

The wide range and myriad types of handicapping conditions suggest equally varied IEPs (Hobbs, 1975; Mercer, 1973). The competencies teachers must thus continue to acquire in order to utilize IEPs as an effective classroom management tool will be numerous and demanding (Fredericks et al., 1979; Horner, 1977; Luckey & Addison, 1974; Stainback et al., 1976; Thomas, 1980; Tucker & Horner, 1977). Brown et al (1980) aptly capture the enormity of this teacher training challenge in an article which carries the rather foreboding title, "Strategies for

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[4]Given the controversy (and ire) it has triggered, the IEP has been thrust centerstage in this discussion for purposes of argument. However, the broader issue is how best to build support systems for teachers beset by the advent of accountability-packed legislation and the IEPs, IDPs (Individual Development Plans), IHPs (Individualized Habilitation Plans), and IPPs (Individualized Program Plans) such mandates spawn, all within the framework of diagnostic/prescriptive instruction.

generating comprehensive, longitudinal, and chronological age-appropriate individualized education programs for adolescent and young adult severely handicapped students"(!). The authors outline the specific instructional decisions and programming tasks facing teachers, emphasizing throughout a main theme: "PL 94-142 mandates that teachers providing special education services to handicapped students design, record, implement, and evaluate IEPs for each of their students" (pp. 199-200; also see Hedbring & Holmes, 1977). To make the challenge even more difficult, the law requires "schools to design and deliver special education services for which there was no precedent and little existing knowledge in the field" (Budoff, 1975, p. 518).

To be sure, then, teachers are on the front lines, charged with implementing PL 94-142 at the classroom level (Hayes & Higgins, 1978). Equally clear is the realization that teachers continue to find themselves largely alone in their efforts to comply in good faith with the IEP mandate. The skills, the inservice training, added preparation time, specialized support services, instructional resources, and administrative leadership that compliance with PL 94-142 regulations entail have not, in a word, been provided (Cortright, 1980; Elmore, 1980; Massie, 1978; Waugh, 1980). It is this seeming mismatch of federal directive and available expertise that of late has generated widespread concern and controversy (Atschuld & Downhower, 1980; Chandler, 1980; Graham & Harris, 1980; Hobbs et al., 1979; Marver & David, 1978; Price & Goodman, 1980; Safer et al., 1978; Semmel & Heinmiller, 1977). Simply stated, those responsible for IEPs are not being upgraded nor updated with the knowledge required to do the job

(Kaye & Aserlind, 1979; Joiner & Sabatino, 1981; Stalford, 1980).

The predictable result of this mismatch appears to be a growing slack in compliance efforts. Garfunkel and Bloom (1980) found in their survey, for example, that "with Public Law 94-142 now in effect nationally, instances of school system noncompliance with state special education law are becoming more prevalent" (p. 35). Moreover, Behrmann (1981) reviewed a recent study prepared for the U.S. Department of Education (Office of Special Education, 1980a).[5] That study found that only about one-third of the more than 2500 IEPs reviewed in some forty states contained all eleven of the "mandated information items." The report concluded that "much more needs to be accomplished before PL 94-142 requirements for the contents of the IEP are met" (Office of Special Education, 1980a, p. 75).[6] Perhaps, then, it was a combination of growing slack in IEP compliance efforts along with continuing confusion about the law itself that prompted the Office of Special Education to release a "draft policy clarification paper on the IEP requirement under PL 94-142" (Office of Special Education, 1980b, p. 25). Nonetheless, the fundamental issue persists: How can the handicapped pupil better benefit from the expertise and technology now

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[5]Previously named the Bureau of Education for the Handicapped (BEH), the Office of Special Education (OSE) is now called Special Education Programs (SEP), effective as of October 6, 1981.

[6]Education Turnkey Systems Inc., a Washington, D.C. area consulting firm, recently completed a study of the impact of PL 94-142 on the delivery of special education services in nine states. A major finding: The law has contributed to turf battles and jealousy over funding, erosion of local control, serious problems of monitoring compliance, increased staff turnover in some state agencies, and a general backlash against special education (see Education Turnkey Systems, 1981).

available? How can the IEP be made to work? The answer may in part lie in a more responsive approach to dealing with local educational priorities.

Implementing IEPs: An Alternative

Policy has been defined as the "description and explanation of causes and consequences of government activity" (Dye, 1976, p. 1). Too often, though, as Farrar et al. (1980b) point out, policy begins as little more than "a set of broad and often diverse intentions" (p. 167; also Turnbull et al., 1981). Rosenberg (1980) contends that such vagueness on the part of policymakers is the result of a tendency to "confuse politics with pedagogy and possibility with reality" (p. 116). He goes on to argue that it is this vagueness at the outset that oftentimes may be a main cause of subsequent nonimplementation of program goals. If PL 94-142 is to achieve its stated goal—that of "assuring the free appropriate public education of all handicapped children"—then amid the vagueness, the confusion, and the controversy, school-level endorsement and compliance somehow must emerge (Turnbull, 1981). It follows, then, that for teachers to be expected to carry out the substantive requirements of the IEP provision, the time and energy required on their part will have to be linked in some way to their own perceived self interests (Bennis et al., 1976; Fullan & Pomfret, 1977; Havelock, 1973; Mann, 1978; McLaughlin, 1976a).

Concerning the linkage systems which must be forged between teachers and support systems accompanying the implementation of IEPs, Mann (1976) has observed that implementation of mandates (such as the installation of IEPs) does not begin until "the project gets down to the

hard work of trying to influence teacher behavior" (p. 325; see also, Berman & McLaughlin, 1976; McLaughlin, 1976).[7] As the new Secretary of Education put it, "the truly excellent programs are those that have been developed and enacted not by the people in Washington, but those closest to the programs' location" (Bell, 1981, p. 65). Farrar et al. (1980a,b) use a "lawn party" analogy to introduce this "user-driven" notion of influencing teacher behavior (cf. Mann, 1978). In contrast to more traditional views of implementation (e.g., Bennis et al., 1976), local school districts no longer are treated as passive hosts to federal mandates. Rather, a sort of lawn party is convened at the local implementation site. At such a party, mutual needs are discussed, priorities set, agendas mapped. In time, the federal program (e.g., IEP provision) evolves to where it addresses, reflects, underscores, and aims to resolve local concerns (cf. Berman & McLaughlin, 1976; cf. Guthrie, 1981; McLaughlin, 1976). What emerges from this mutually responsive gathering is the unmistakable understanding that "local forces (the guests) are at least as important as federal intentions (the host) in determining the final form of federal policy and program (the

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[7] An extended treatment of the literature on "teacher-change" exceeds the primary focus of this study. However, the reader is referred to the following sources for a comprehensive review of strategies employed to encourage planned change (including teacher behavior): (a) **Innovation:** Budoff, 1975; Halperin and Kaplan, 1976; Kirp et al., 1974; Pincus, 1974. (b) **Implementation:** Allison, 1971; Berman, 1978; Berman and McLaughlin, 1976; Education Turnkey Systems, 1978, 1981; Elmore, 1978, 1980; Fullan and Pomfret, 1977; Havelock, 1973; Radin, 1977; Scott and Shore, 1974; Stalford, 1980; VanMeter and VanHorn, 1976. (c) **Compliance:** Bandura, 1977; Harvard Law Review, 1977; Lufler, 1980; Mann, 1976, 1977, 1978, 1979; McLaughlin, 1976b; McLaughlin and Berman, 1977. (d) **Staff development:** Arends et al., 1979; Lieberman and Miller, 1979; Mann, 1979; McLaughlin and Berman, 1977; McLaughlin and Marsh, 1978; Miller, 1977; Speidel and Tharp, 1978.

party)—and usually more so" (Farrar et al., 1980b, p. 168; also Mann, 1974, 1978).[8] Adopting such an implementation thrust works toward removing the perceived threat and anxiety from the IEP (or other federally initiated) mandate. As a result, the IEP might come to be viewed more as a management tool rather than an accountability weapon. Knowing they have greater input, teachers may enjoy greater impact. To be sure, it can be anticipated that they would at least feel more comfortable sharing with others (administrators, applied researchers) instructional problems encountered in classrooms. In time, this atmosphere of collegiality, of support and consultation, might lead to a more coordinated approach to instructional planning (Ginsburg & Turnbull, 1981). At the same time, renewed emphasis upon local control through coordinated, cooperative planning might result in more vigorous experimentation with proven, practical research outcomes for solving some of the many learning problems displayed by handicapped pupils (Klein et al., 1979; Seeley, 1979). Sensing increased teacher acceptance of experimental results that offer at least a measure of relief for enduring classroom problems, applied researchers might be motivated to redouble efforts to conduct studies that afford immediate, practical, direct benefits to teachers of handicapped pupils. The result: a narrowing of the theory-into-practice gap that persists in special

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[8] Farrar et al. (1980a) use the example of low-income housing to underscore a positive outcome of this evolutionary process: "The final products," they say, "may differ in quality, or number of rooms, but there is little chance that something other than houses will be built. Neither swimming pools nor fire engines will line the newly built street, nor will housing units contain only kitchens and bathrooms" (p. 83).

education. However speculative at first glance, of course, such an attitude of professional cooperation becomes especially important when classroom teachers come face to face with a learning handicap known as stimulus overselectivity.

Overselectivity: A Learning Handicap

> Nothing is quite as useless to a teacher as an empirically supported curriculum or instructional objective that is inoperable in terms of classroom conditions.
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> (Hirshoren and Burton, 1979, p. 4)

Aristotle once stated that "...consideration must be given to the question, what constitutes education and what is the proper way to be educated" (after Barker, 1958, pp. 311-312). For the severely and profoundly handicapped, this question has been raised with regard to what skills should be taught to this population, how should those skills be taught, and whether skills selected should be taught in spite of the handicap (e.g., Sontag et al., 1979) or in light of the handicap (e.g., Baumeister, 1981; Burton & Hirshoren, 1979; Ellis, 1981). Gardner (1971) suggests in this regard that "the role of the special education teacher is to provide a total program which will maximize the learning and performance of the students" (p. 255). The instructional objective (to use an IEP term) central to a "total program" approach then becomes the teaching/learning of concepts (Becker et al., 1975). Instrumental to concept development, in turn, according to Gagne (1977) and others (e.g., Snell, 1978; Tawney, 1979), is the ability to discriminate among dissimilarities and to generalize across similarities. Taken together,

these skills form a hierarchy of instructional objectives--goals which require, it should be emphasized, the fundamental skill of attending behavior as a learning prerequisite (Gibson, 1969; Zeaman & House, 1979). Clearly, virtually all IEP-relevant instructional objectives require attending behavior as a prerequisite ("starter") skill.

It is evident that, increasingly, severely handicapped pupils are entering public schools (Office of Special Education, 1980a); included in this group are large numbers of autistic children (Arick & Krug, 1978; Koegel et al., 1980; Marcus, 1979; Rincover et al., 1978).[9] At the same time, however, recent research has found that, when confronted with an instructional task, many autistic pupils respond to seemingly irrelevant, inappropriate aspects of the learning situation. For example, rather than attending to a task request, such children instead may focus on a piece of clothing, a distant noise, or an incidental teacher-gesture (e.g., finger pointing). Similarly, when introduced to even a simple matching-to-sample or picture discrimination task, the autistic child may attend to a portion of the picture that is extraneous to making the correct response (e.g., observing only the spoon of a spoon/bowl drawing, thus matching the spoon/bowl picture with, say, a spoon/plate card). In either case, the net result is a consistent pattern of incomplete and/or incorrect responding which can severely impair academic performance. This tendency for autistic children to

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[9] "Autism" initially was included in the Act as one of several handicaps subsumed under the broader category labeled "seriously emotionally disturbed". However, recent changes in terminology has resulted in the label of "autism" being shifted from the category of seriously emotionally disturbed to that of "other health impaired" (Federal Register, 1981, p. 3865).

attend exclusively to aspects of a task which are irrelevant to successful performance has been termed overselective attention or "stimulus overselectivity" (Lovaas et al., 1971).

Bloom (1974) has investigated the link between attention and student achievement. "The amount of time the student (spends) directly on a (task)," he observes, "accounts for about three fifths of the achievement variation of students" (p. 686). Building on the early work of Carroll (1963) and his contemporaries (e.g., Anderson, 1981; Bloom, 1976, 1980; Fredrick & Walberg, 1980; Gage, 1978; Ornstein & Levine, 1981; Reith et al., 1979; Rosenshine, 1979; Walberg et al., 1979; Wiley & Harnischfeger, 1974), McCormick et al. (1979) extended the investigation of attention to the handicapped and found that "with careful instructional programming (precision of objectives, performance measuring techniques, etc.), the instructional time on task for this population can be increased" (p. 307). Ross (1976) recently reemphasized the importance of attention to learning: "If one could discover techniques to teach (autistic) children the skill of attending to all relevant aspects of a stimulus in a learning situation, one would contribute significantly to their education" (p. 54).

Presently, numerous curriculum guidelines, programs, and products exist which emphasize the central importance of attention to both discrimination learning and concept development (e.g., Bricker & Dennison, 1978; Bricker et al., 1976; Oryx Press, 1981; Robinson & Robinson, 1978; Tawney, 1979). Moreover, a number of instructional strategies useful for training attention as a critical starter skill also are available to practitioners (Baker et al., 1980; Gibson, 1969;

Gold & Scott, 1971; Irvin, 1976; Scott, 1966; Stevenson, 1972; Trabasso, 1968; Wehman, 1979). Yet there exist at present no strategies for assisting teachers in a parsimonious way to overcome deficits associated with overselective attention.[10]

In that sense, applied research clearly has lagged behind the instructional needs of teachers, and the "theory-practice" gap thus persists. Accordingly, if an instructional program could be developed that (a) afforded easy identification of overselectivity, (b) helped to remediate the problem once identified, and (c) permitted both the identification and remediation of the handicap to take place within the classroom setting, classroom teachers clearly could be better served. Moreover, an added dividend might obtain: With such practical and empirical assistance, teachers of the handicapped might prove to be more receptive to the onerous demands placed upon them by federal mandates that require pupil performance gains to be clearly related to teacher instruction. Where that task is made easier, perhaps then each pupil will "Become All (S)he Is Capable of Being" (Dewey, 1932, p. 109).

Statement of the Problem

Regarding the importance of attention to eventual attainment of IEP-embedded objectives, then, the following conclusions are warranted on the strength of research to date: (1) More and more autistic pupils

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[10] When applied to instructional procedures, parsimonious refers to the use of minimum teacher input(s) to produce maximum pupil output per unit time.

are seeking a publicly supported, appropriate education. (2) In such public school settings, these autistic children often perform poorly on even simple academic and pre-academic classroom tasks. (3) A skill essential to improved classroom performance of autistic children (and others) is attention—the ability to focus on a task request and then to perform the task correctly within a reasonable amount of time. (4) Logically, then, IEPs for autistic pupils should address the development of attending behaviors. (5) Unfortunately, autistic children in particular exhibit an added handicap in the process of acquiring attending skills—that of stimulus overselectivity. (6) No practical strategies applicable to classroom settings are available for remediating stimulus overselectivity. Thus, the purpose of this study will be to compare two classroom-based instructional strategies for remediating attentional deficits of autistic school-age children overselective in the visual modality.

Chapter 2

REVIEW OF THE LITERATURE

Federal and state regulations accord high priority to the severely handicapped who, until recently, were denied access to publicly supported education. Legislation in most states now stipulates that any school-aged child diagnosed as "handicapped" in accordance with federal guidelines is entitled by law to an IEP if that child is found to be in need of special education instruction (Office of Special Education, 1980a).

As mentioned, crucial to the success of diagnostic/prescriptive instructional programming in general and, at this point in time, to IEPs in particular is the starter skill of on-task attention. The ability to attend to the task at hand underpins practically every skill a pupil is striving to acquire. At the same time it has been pointed out that increasingly, teachers of autistic children are encountering a learning handicap which signals not only a serious deficit in the area of attention, but which calls for new knowledge and a more readily usable approach to dealing with it.

To more fully understand both the importance of attention to learning and of overselectivity as a learning handicap, both concepts require a more studied review. Accordingly, a brief discussion of recent advances that have been forthcoming in programming for autistic children will be used to introduce an argument in favor of adopting behavioral-based training strategies with this "hard-to-teach"

population. Through an overview of perception, perceptual development, and the role which attention assumes in both, the concepts of selective attention and overselectivity will be introduced in detail. Following that discussion, the early research on overselectivity and the more recent follow-up attempts to remediate the handicap will be addressed, with particular emphasis accorded several problems and shortcomings attendant to those remediation efforts. Finally, two intervention which may prove of more practical value to classroom teachers who encounter overselective pupils will be introduced, with the following chapter devoted to outlining those interventions in detail.

The Syndrome of Autism: Descriptors

Given the importance of maximum integration of the severely handicapped into public school settings, children selected for participation in applied research that investigates instructional strategies should probably meet two broad screening criteria. First, each child should be school-aged and satisfy the definition of "severely handicapped" as set forth in the PL 94-142 statute as amended (Federal Register, 1981). Second, within the severely handicapped category, each pupil selected should meet the descriptive definition of autism provided by Rutter (1978) and/or that of American Psychiatric Association (DSM-III, 1980). In general, the following diagnostic strands have been rather widely accepted as typifying children believed to be autistic: (1) Onset -- prior to 30 months of age. (2) Language deficiency -- gross deficits in language development; receptive and expressive language absent or minimal; echolalia; speech, when present, used mainly

as a "go/no go" signal. (3) Sensory deficits — appear deaf and/or blind under certain stimulus conditions; exaggerated reactions to similar stimuli—e.g., inordinate awareness and sensitivity to nearly imperceptible sound or to very loud sound; minimal reaction to pain or extreme reaction to touch, sound, and smell. (4) Social isolation — pervasive lack of responsiveness to other people; absent or minimal social interaction; attraction to inanimate objects; self-stimulatory behavior; stereotypies; ritualistic responses; preservation of sameness; absent or minimal self-help skills; self-injurious behaviors.[11]

It is in light of these widely fluctuating behaviors that a systematic, individualized approach to instructional programming is called for. To be sure, numerous applied researchers have urged that greater attention be directed to instructional arrangements which in fact would emphasize a high degree of classroom structure, prerequisite skills training (e.g., object recognition, visual discrimination, functional object-use, equivalence matching), and a behavior management

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[11] That these diagnostic signals are vague is apparent. Not surprisingly, then, "the autism diagnosis fails to indicate the etiology or probable course of the disorder, does not narrow the range of potentially effective treatments, and does not specify the prognosis" (Newsom & Rincover, in press). Recent efforts suggest, however, that some progress is being made in upgrading the level of clinical specificity and objectivity in the differential diagnosis of autism (e.g., Koegel et al., 1980; Krug et al., 1979; Rutter, 1978; Schopler, 1978). The reader is referred to the following sources for a more detailed discussion of descriptive characteristics which to date serve to define the syndrome of autism: Bartak and Rutter (1976, pp. 111-116), Kanner (1965, pp. 412-414), Lovaas (1976, pp. 30-31), Lovaas et al. (1973, pp. 3-4), Lovaas and Newsom (1976, pp. 308-309), Lovaas et al. (1978, pp. 385-388), Margolies (1977, pp. 249-250), Newsom and Rincover (in press), Ornitz and Ritvo (1976, pp. 609-615), Rutter (1968, 1978), Schopler (1978, pp. 35-45), Ward (1977, pp. 354-357), Wing (1976, pp. 15-48).

technology (Bijou & Baer, 1978; Dunlap & Koegel, 1980a; Koegel et al., 1982; Lovaas, 1981; Newsom et al., 1979; Rincover & Koegel, 1977b).[12] Moreover, a considerable literature has accrued during the past quarter century which supports such a view and thus deserves brief review.

A Behavioral Technology for Teaching Autistic Pupils

Lindsley (1964) contended some time ago that "children are not retarded. Only their behavior in average environments is sometimes retarded" (p. 62). The strides that have been made in shaping human behavior over the past several years underscores the validity of that assertion (Bijou, 1977; Bijou & Baer, 1978; Kazdin, 1978; Malott et al., 1978). At the same time, the advent of an instructional technology for teaching the handicapped has resulted in a dramatic increase in both the quantity and the quality of instructional programs and products now available to practitioners (e.g., Becker et al., 1975; Gerweck, 1978; Gold, 1981; Hedbring, 1977; Kissinger, 1981; Meyen & Altman, 1973; Popovich, 1977, 1981; Popovich & Laham, 1981; Snell, 1978; Sontag, 1977; Tawney, 1979; VORT, 1979). Indeed, such progress led Bijou (1972) to conclude early on that "...when a child fails to make progress, the course of action is clear: analyze the source of the problem, present a modified set of conditions, monitor the child's performance under the new conditions, and revise the conditions again if necessary until the

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[12]By "systematic" is meant intervention characterized by pre-assessment, behavioral objectives, individual-specific training sequences, data-based performance monitoring, and continuous program evaluation (Hedbring, 1977; Meyen, 1978).

child shows progress" (p. 28). Not surprisingly, this advice seems to have been incorporated in large part into the diagnostic/prescriptive requirements for developing IEPs.

Conditions of Learning

Over the past two to three decades, a set of learning conditions to which Bijou refers has evolved from the early "laws" of animal behavior (Kazdin, 1978; Skinner, 1953; Watson, 1913, 1930). The functional relationship (Bijou, 1966) between general conditions of learning—antecedent setting events, stimulus context, behavioral consequences (to name but three)—and response patterns of pupils increasingly was revealed by these and other infrahuman studies.[13] As a result of the recognition of this systematic link between instruction and behavior, Bloom (1980) recently stated that "student learning can now be improved greatly; it is possible to describe the favorable learning conditions that can enable virtually all students to learn to a high standard" (p. 382).

Initial attempts to describe and refine these conditions with the handicapped began with the pioneering studies reported by Fuller (1949) in his work with a "vegetative human organism" and later by Lindsley (1956) in his research with "chronic schizophrenics." Subsequently, the work of Ferster (1961) and Ferster and DeMyer (1962) marked perhaps the

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[13]For an elaboration of the internal conditions (within the learner: e.g., coding, memory, recall, closure) and external conditions (specific to the learning context: e.g., practice, feedback, reinforcement, task cues) and how both are functionally related to some eight types of learning and five varieties of learning capabilities, see Gagne, 1968, 1977, and Gagne and Briggs, 1979.

first effort to apply these early discoveries to autistic children. From such conditions in recent times have evolved the more specific principles of teaching.

Principles of Teaching

Greater understanding of the broad conditions which influence learning has resulted in a relative shift from curriculum description (stating what to teach) to concern with instructional prescription (stating how to teach) (Bagnato & Neisworth, 1981; Gage, 1978; Sailor et al., 1980). Numerous studies indicate, for example, that the conditions of learning exemplified by Ferster and DeMeyer are functionally related to many of the instructional gains made by autistic pupils. As a case in point, Wolf et al. (1964) found that subsequent to an operant-based instructional program initiated with a three and a half year old autistic boy, the child learned to wear glasses without which an opthalmalogist had predicted possible blindness. Their follow-up study three years later found that "...after three years of intensive application of operant behavior modification techniques, (the pupil had) progressed from 'hopeless' to the point where he was able to take advantage of a public school education program" (Wolf et al., 1967, p. 110). Hewett (1965) documented similar success in his use of operant principles (viz., primary and secondary reinforcement, shaping) as part of a speech training program. This instructional program began with attention training (eye-to-eye contact). Motor imitations next were developed to a point where simple verbal imitations were able to be learned by the pupil. The final phase of instruction achieved the goal of generalizing the set of learned skills from the special training

booth to the hospital ward. Through these and other (even earlier) investigations (e.g., Itard, 1962; Seguin, 1907), several principles of learning have been derived which promote more rapid attainment of instructional goals, including Differential reinforcement, reinforcement scheduling, shaping, prompting, fading, chaining, modeling, and extinction. These and other principles have been found to facilitate the acquisition of new behaviors—oftentimes when other approaches (e.g., psychotherapy) have failed.[14]

In summary, the studies briefly reviewed are important for several reasons. First, they demonstrate that human behavior in general can be brought under predictable instructional control through the application of a behavioral technology of teaching (e.g., Kazdin, 1978; Scarr, 1979). Such studies thus typify the gains which more traditional approaches to instruction have not widely enjoyed (Dunn, 1973). Second, applied behavioral technology has proved to be a most parsimonious approach to teaching the handicapped (Bijou, 1972, 1979; Bijou & Baer, 1978; Etzel & LeBlanc, 1979; Lovaas & Koegel, 1973). That is, behavioral gains generally are found to relate directly to systematic programming strategies (Newsom et al., 1979). Third, the studies offer an empirical rationale for selecting behavioral-based training strategies for teaching autistic pupils (Koegel et al., 1980; Kozloff, 1974; Lovaas, 1981; Lovaas et al., 1978; Rincover & Koegel, 1977; Rincover et al., 1978; Schreibman & Koegel, 1975, 1981). In contrast,

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[14]For excellent reviews, discussion, and empirical examples of these teaching principles, see Ball, 1971; Bandura, 1969; Kazdin, 1975; 1978; Krumboltz and Krumboltz, 1972; Madsen and Madsen, 1970; Malott et al., 1978; Whaley and Malott, 1971.

treatment strategies that are psychoanalytic (Bettelheim, 1967), psychodynamic (e.g., Oppenheim, 1974), that presume biochemical brain dysfunction (e.g., Rimland, 1964), or infer an "emotional deficiency" either in the child or parent(s) (Creak & Ini, 1960; Pitfield & Oppenheim, 1964; Schopler & Reichler, 1972) have in the past too often led to an unhappy ending: "Therapists felt they were giving a lot but not getting much back" in the way of treatment gains (Lovaas et al., 1978, p. 388; cf. Kozloff, 1973). To quote Bijou (1972) in this regard, "escape hatches attributing lack of progress to mental retardation, learning disabilities, or other traits (such as autism) are closed" (p. 28). Fourth, the studies (and the behavioral principles they reflect) utilized, perhaps for the first time, a single-subject research design (Baer et al., 1968; Hersen & Barlow, 1976; Sidman, 1960). Such a design permits the "strong inference" (Platt, 1964) that a program of instruction itself is responsible for individual improvement, rather than other, "internal threats" (Campbell & Stanley, 1963). Fifth, the seminal studies reported by Wolf and his colleagues offer early evidence that the results of instruction can, if programmed, generalize to extra-therapy settings (Fawcett et al., 1980; Stokes & Baer, 1977). Sixth, the studies serve to illustrate a set of instructional rules that may be used to guide the public school programming activities of teachers.

Rules of Instruction

Sontag et al. (1973) have observed that "there is a direct relationship between the level of a student's disability and the level of instructional competence required of the teacher; the more pronounced

the disability, the greater and more precise the skills required of the teacher" (p. 23; Wilcox, 1977, p. 418). So, on the one hand it may now seem beyond serious question that an instructional technology exists which allows the teacher to "set forth rules specifying the most effective way to achieve knowledge or mastery of skills" (Glaser, 1976, p. 4). Even given the wide variation typically found in autistic-like behavior, the literature seems to suggest that those rules may be more critical than ever—if IEP-stipulated annual goals and shorter-term instructional objectives are to be achieved. Accordingly, for those planning to teach autistic children, there are several areas of instruction in which such practitioners should probably be skilled. Those instructional competencies include include the following: (a) direct measurement techniques (Cone, 1978; Haring, 1977; White & Liberty, 1976), (b) reinforcement procedures (Glaser, 1971; Hall, 1971), (c) imitation and prompting tactics (Peterson, 1968; Russo & Rincover, 1977; Striefel, 1974), (d) shaping/fading procedures (Koegel et al., 1977; Sailor et al., 1980), (e) one-to-one teacher-student instruction (Haring & Gentry, 1976; Russo & Koegel, 1977), (f) larger group instructional techniques (Rincover & Koegel, 1977a), and (g) program evaluation (Budde, 1979; Meyen, 1979; Raizen & Rossi, 1981; Stalford, 1980; White & Haring, 1978a). Increasingly, these rules are being translated into teacher competencies and are finding their way into a growing number of exemplary special education personnel preparation programs across the country (e.g., Blackhurst, 1977; Brown & York, 1974;

Fredericks et al., 1976, 1979; Horner, 1977; Tucker & Horner, 1977).[15]

In sum, the empirical knowledge accumulated during the past twenty-five years or so demonstrates clearly that autistic pupils now entering public educational settings under the press of PL 94-142 can be taught a variety of skills. Through the systematic application of instructional rules to properly structured learning conditions, autistic children have been able to (a) increase their level of motivation (Ferrari & Harris, 1981; Kish, 1966; Koegel & Egel, 1979; Ragland et al., 1978; Rincover et al., 1977; Williams et al., 1981); (b) acquire motor (Metz, 1965; Zucker et al., 1978) and verbal skills (Lovaas et al., 1966, 1967; Luce et al., 1980); (c) decrease rates of self-stimulation (Koegel et al., 1974; Rincover, 1981) and self-injurious behavior (Wolf et al., 1964); (d) build complex language patterns (Bates et al., 1975; Lovaas, 1977); (e) serve as peer tutors in elementary discrimination training activities (Hedbring, 1975); and (f) generalize acquired skills beyond the instructional setting (Hewett,

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[15]The following sources may be consulted for a more complete review of the conditions, principles, and rules encompassing systematic instruction: (a) behavior modification (Bandura, 1969; Craighead et al., 1976; Honig, 1966; Kantor, 1959; Kauffman & Snell, 1977; Kazdin, 1978; Krumboltz & Krumboltz, 1972; Lent & McLean, 1976; MacMillan, 1973; Malott et al., 1978; Neuringer & Michael, 1970; Spradlin & Girardeau, 1966; Thompson & Grabowski, 1977; Ullmann & Krasner, 1975; Watson, 1913, 1930); (b) operant conditioning (Baer, 1975; Lindsley, 1963; Reynolds, 1968; Skinner, 1972, 1974, 1979); (c) applied behavior analysis (Baer et al., 1968; Bijou, 1966, 1972, 1975, 1978; Homme, 1970, Kazdin, 1975); (d) modeling/imitation (Bandura, 1977; Peterson, 1968); (e) measurement (Bushell & Burgess, 1969; Cooper, 1974; Hersen & Barlow, 1976; Kazdin, 1977; White & Liberty, 1976); (f) evaluation (Haring, 1977; Haring & Bricker, 1976; Krug et al., 1979; White & Haring, 1978); and (g) with autistic pupils (Bartak & Rutter, 1976; Lovaas & Bucher, 1974; Lovaas & Koegel, 1973; Lovaas et al., 1973, 1974; Lovaas et al., 1978; Lovaas & Newsom, 1976; Margolies, 1977; Schreibman & Koegel, 1975).

1965; Koegel et al., 1977; Russo et al., 1981; Sanders & Glynn, 1981; Wolf et al., 1967). Such gains permit the acquisition of behaviors which then may be used developmentally as building blocks for yet more complex behaviors. The result has been a wide proliferation of teacher training and curriculum programs that increasingly permit the autistic pupil to engage in activities similar to those of mainstream nonhandicapped classmates (Bachrach et al., 1978; Donnellan et al., 1977; Dunlap & Koegel, 1980; Handleman, 1981; Koegel, 1981; Kozloff, 1973; Kugelmass, 1970; Lovaas, 1981; Paluszny, 1979; Romanczyk & Lockshin, 1981).[16]

Plainly, then, much can be accomplished with learning handicapped pupils labeled as autistic. At the same time, it must be emphasized that a prerequisite behavior that permits the development of these and other skills is on-task attention. In short, little progress in acquiring and maintaining more complex skills can be possible if these youngsters are handicapped further by deficits in attending behaviors.

Attention and Perceptual Development

Perception has been described as "the process by which the child extracts meaningful information from the meaningless mosaic of physical stimulation" (Mussen et al., 1974, p. 278). What is extracted are the

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[16]Of course, with the advent of powerful technologies comes the potential for abuse. In the case of behavior modification, the following sources provide a sample of the concern being expressed in many quarters for both the real and the perceived abuses such tactics can engender: Agras, 1973; Ayllon, 1975; Davison & Stuart, 1975; Friedman, 1975; Goldiamond, 1975; Holland, 1978; Kazdin, 1978; Martin, 1975; Sajwaj, 1977; Stolz, 1977; Szilak, 1976; Tryon, 1976; Wexler, 1973, 1974, 1975.

"properties, patterns, and distinctive features" of the surrounding environment (Gibson, 1969, p. 7). In this way, perception becomes a function of human growth and development. What develops is the child's increasing ability to search, explore, select, filter, and abstract--to differentiate and discriminate information about objects, patterns, events, and space. As Mussen et al. (1974) suggest, perception is a process of learning how to become a good detective, of knowing "how to interpret clues and knowing the best place to look for them" (p. 282). By definition, then, critical to perception is attention.

Attention

For Gibson (1969), "perception is action, exploratory action....Exploration is directed and becomes increasingly directed with development. The directive aspect of perception is attention" (p. 121). Berlyne (1970) goes on to distinguish between two classes of attention--**intensive** aspects of attention (degree of concentration) and **selective** attention, of which there are three forms (selective attention in learning, selective attention in performance, and selective attention in remembering) (pp. 28-33). This discussion will be directed largely to concerns about attention in **performance**; that is, what regulates the perceptual process by which a child selects from the seemingly unlimited stimuli that competes for that attention. According to Ross (1976), the main contribution of Berlyne's theoretical work was the suggestion that "the technical use of the word (attention) be limited to only one aspect, that of selective attention" (p. 39).

Selective Attention

Quay and Weld (1980) define selective attention as the "act of selecting and processing the important and ignoring the unimportant information from the vast amount of input that is available to the child at any given time" (p. 117). Linking attention to achievement, Carroll (1963) was even more direct: "The time during which the person is oriented to the learning task and actively engaged in learning is related directly to success in learning a given task" (p. 725). In short, "the student who pays more attention learns more" (Rieth et al., 1979, p. 55).

Zeaman and House (1963) found in their early work on selective attention that differences in skill acquisition between retarded and non-retarded learners is in large part the inability of the former to attend to the appropriate dimension or feature of an instructional task. Their research indicated that visual discrimination learning is a two-stage process of selectively attending first to the dimension (e.g., shape, size) of an object, pattern, or task, and only then attending to the relevant feature (e.g., roundness, smallness) of that stimulus dimension. While their original theory has been reworked over the years (e.g., Zeaman, 1965, 1973), the role that attention necessarily assumes as a pre-condition for learning has not diminished (Gelman, 1969; Hale & Lewis, 1979; cf. House et al., 1979; Lane, 1979).[17]

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[17]For an excellent, nontechnical history of the development of the House-Zeaman multi-look theory of attention, see Zeaman and House, 1979. See also, Mostofsky (1970, pp. 10-11) and Trabasso and Bower (1968, pp. 1-43) for brief discussions of several concerns attendant to the model.

Fantz et al. (1975) contend that the dimension to which Zeaman and House refer must somehow be "discovered" by the learner (p. 340). Much of Gibson's (1969) interest has focused on this very problem. Gibson contends that selective attention is a developmental phenomenon, a process of learning to isolate the critical features that distinguish objects, patterns, and events from one another (pp. 15, 77). Further, Gibson contends that children learn first to attend to objects. Because of poorly developed visual exploratory behavior (Wright & Vliestra, 1975), young children (under the age of six) are "scanners;" that is, they exhibit "crude compulsory fixation" tendencies (Gibson, 1969, p. 411; Santostefano, 1964). "The point to be noted is their primitive tendency to center on a single striking feature of an object with rigidity of focusing instead of exploration" (Gibson, 1969, p. 343). Objects, then, in contrast to patterns, are "easier" to perceive developmentally, probably on account of their redundant "bundles of features" (Gibson, 1969, pp. 82, 341). The finding that young children under the age of six develop object perception before pattern perception has been documented extensively over the years (Cohen & Gelber, 1975; Fantz et al., 1975; Ginsburg & Opper, 1978; House & Zeaman, 1960; Iscoe & Semler, 1964; cf. Pick et al., 1972).

Engineering Selective Attention

It is important to recognize, however, that "most autistic children function at an infant or preschool level" (Bryson, 1970, p. 239; also Lovaas et al., 1978; Newsom, 1981). Within the Piagetian framework, such children thus function at the sensorimotor stage of development (Ginsburg & Opper, 1978; Lipsitt, 1981; Stephens, 1977). At this level,

learning activities should be geared primarily to such developmental milestones as imitation, means-ends, causality, and object permanence (Cohen & Gelber, 1975; Olver & Hornsby, 1966; Robinson, 1976; Rogers, 1977). Moreover, Piaget has pointed out that at this stage of perceptual development, "manipulation of materials is crucial, (for) materials encourage progression. It's the materials (the child) should learn from" (in Duckworth, 1973, pp. 22-23). Indeed, Fantz et al. (1975) have found that "manual and other active exploration possibilities begin to influence selectivity...late in the first six months" (p. 339), a conclusion reflected indirectly in other perceptual literature (e.g., Cohen & Gelber, 1975; Fantz, 1966; Gibson, 1969). Clearly, then, active participation on the part of the child at this stage is fundamental to perceptual development (Klein & Safford, 1977; Woodward, 1979).

Given that "perception is selective by nature" (Gibson, 1969, p. 3), given that attention training should promote "discovery" of the relevant dimension(s) and feature(s) of objects, what are some effective "attention getting" tactics instructional strategies can employ? In answer to this question, Krugman (1975) provides a useful analogy from the field of print advertising. He contends that a successful "message" must have three critical ingredients in order to attract the (selective) attention of "consumers." First, the ad must contain "news." It must offer something that will "catch the eye." Second, ads must invoke a need or want on the part of the consumer. Third, ads must emphasize some aspect of the message the advertiser wishes to convey. To borrow from a recent advertisement for RCA TVs, the task facing the classroom teacher may, first and foremost, be one of "trapping" the child's attention--of

working to "grab it, align it, define it, sharpen it, tone it, and to lock the (pupil's attention) on track."

Following the lead of Zeaman and the notions of Krugman, then, training programs should probably focus upon ways to advertise tasks--to lock attention on track--such that young consumers can learn to detect the important dimensions and features of objects (and later, patterns). In this regard, Wright and Vliestra (1975) note that "selective attention begins with determination by saliency and proceeds towards information processing based on the dimensions or features attended to initially" (p. 204). Object saliency, in short, is the key to effectively advertising instructional tasks (Fantz et al., 1975; Gibson, 1969; Wright & Vliestra, 1975). Specifically, contrast (color, texture, weight), size, contour (rough vs. smooth, round vs. squared edges), complexity (multiplicity of angles, object mobility, infusing the object with light and/or sound), novelty (how often, how recently the child visually or haptically has used the object), and brightness (in color or lighting) all experimentally have been identified as enhancing saliency in the development of object perception (Fantz et al., 1975; Gibson, 1969; Lubker, 1967, 1969a,b; Stevenson, 1972).[18]

In summary, the challenge of directing the attention of autistic

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[18]While the preeminent importance of saliency to the development of object perception is acknowledged, a detailed review of the experimental literature is beyond the intent of the present discussion. The reader is thus referred to the following sources for a sampling of such literature: Bower, 1975; Brown, 1969; Hagen and Huntsman, 1971; House and Zeaman, 1960; Houston, 1967; Klatzky, 1978; Lawrence, 1950, 1952, 1955; Lubker, 1967, 1969a,b; Marker, 1979; McGurk, 1974; Paris and Lindauer, 1978; Pick et al., 1972; Shepp and Zeaman, 1966; Trabasso and Bower, 1968; Trabasso et al., 1966; Ullman and Routh, 1971.

children to the relevant features of instructional tasks is multi-faceted. First, the teacher must be trained in the application of the rules of instruction if performance gains are to be realized. Otherwise, it will be difficult for the teacher to distinguish between those "bundles of features" that the (s)he knows are relevant ("nominal stimuli;" i.e., will result in correct, rewarded responding) and those features which the pupil believes to be relevant ("functional stimuli") (Underwood, 1963). Such a distinction underscores the importance of "saliency strategies" to engineering selective attention. Second, the child should be provided with activities which require active physical manipulation of materials. Given the sensorimotor functioning level of autistic children, initial learning tasks should utilize objects. Third, those tasks should involve strategies that will effectively advertise the critical features of the materials. Finally, the importance of practicality should be emphasized. That is, instructional activities should be woven around existing materials and programs. The role of the teacher is to engineer those products in new and creative ways. Unfortunately, the considerable challenge already facing the teacher under state and federal mandate may be made yet more difficult in cases where autistic children display deficits in selective attention.

Overselective Attention

Butler and Rabinowitz (1981) define stimulus overselectivity as "the tendency of some (individuals) to learn about only a small portion of the information presented in a stimulus array" (p. 430). Research conducted during the past several years has found, rather consistently,

that many autistic children exhibit such a tendency. Specifically, autistic children "attend to environmental stimuli highly selectively, much more selectively than do normal children of the same age" (Lovaas & Newsom, 1976, p. 338). They attend so exclusively to such a narrow range of sensory input, in fact, that they either (a) process "messages" (stimuli) that are wholly irrelevant to the correct completion of an instructional task, or (b) they ignore altogether sensory input critical to the task (Lovaas et al., 1978). Thus, children who overselect visually appear functionally deaf; they tend to "hook onto" the visual cues of a stimulus complex exclusively (Lovaas & Koegel, 1973, p. 252). Similarly, autistic pupils who overselect in the auditory modality act as if they are functionally blind; that is, they attend to auditory cues to the total exclusion of visual (or tactile) input (Arick & Krug, 1978). In either case, such children are unable to respond correctly to multiple sensory input—to the complex stimuli that characterize "less restrictive," more "normalized" instructional environments (Lovaas et al., 1971; McDonald & Sheperd, 1976). While youngsters by age six are able to "attend to three or more stimulus components and select the one most pertinent to their needs" (Gersten, 1980, p. 49; also Eimas, 1969), autistic children seem unable to exhibit this perceptual behavior. Lovaas (1977, 1980, 1981), in his work with autistic children at U.C.L.A., hypothesized that this restriction might be due to a specific learning handicap in the area of discrimination learning. Because of the peculiar nature of the handicap and because it related to a breakdown in the process of selective attention, Lovaas and his colleagues originally

labeled the handicap, "stimulus overselectivity."[19]

Early Research

In the classic study that initiated much of the research on modifying overselective attention, several investigators were curious as to why autistic children typically performed so poorly on elementary discrimination tasks (Lovaas, Schreibman, Koegel, & Rehm, 1971). Accordingly, they conducted a study that included a three-component stimulus. The stimulus for the task was a compound consisting of (a) a visual cue (red light), (b) an auditory cue (noise), and (c) a tactile cue (pressure applied to the leg). Three groups of subjects (mentally retarded, autistic, normal) were then presented with a discrimination task. Specifically, all were taught to press a bar in the presence of all three components of the stimulus complex, and not to press the bar in the absence of one or more of the components. Since the task consisted of a combination of three stimuli, a correct discrimination "could be made even if the child attends to only one of the stimulus dimensions" (Schover & Newsom, 1976, p. 290).

After the discrimination was learned, individual components of the three-cue compound were separated and presented singly to each subject.

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[19] The original term, "stimulus overselectivity" (Lovaas et al., 1971) has since been referred to variously as as "overselective attention" (Schreibman & Lovaas, 1973, p. 152), "selective responding" (Rincover & Koegel, 1977, p. 345), "overselective responding" (Schreibman & Lovaas, 1973, p. 165), "overexclusive attention" (Ross, 1976, p. 41), and even as "autistic overselectivity" (Lovaas et al., 1971, p. 545). While this disussion also uses the terms interchangeably, a more technically accurate term would be "visual overselective attention," given the specific modality the present study addresses.

Results showed that the normal controls responded as expected: They pressed the bar when each of the three cues was presented. However, the autistic children selected only one of the three cues and consistently responded on the basis of that single cue alone.[20] Thus, those who locked onto the visual component (light) failed to respond correctly when either the auditory or the tactile cue was presented. Similarly, autistic subjects who attended overselectively to the auditory component ignored both the visual and the tactile cues; those attending solely to the tactile stimulus likewise ignored totally the visual and the auditory cues.[21]

Spread of Effect

Schreibman and Lovaas (1973) extended the Lovaas et al. (1971) findings in their study of the impact of overselectivity on the social interactive behavior of autistic children. The rationale for the study

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[20]Definitionally, the term coined to describe this phenomenon is arbitrary. Lovaas et al. (1971) decided logically to relate the term overselectivity to those cue(s) incorrectly selected too frequently. However, experimentally and in terms of remediation, it makes little difference whether or not the cues studied are those which are overselected or those cues ignored--those which are underselected. The end result in both cases is a high frequency of selecting cues inappropriate/incorrect to the correct completion of the task at hand. In any case, from a technical standpoint, a more precise term may in fact be "restricted stimulus control" (see Litrownik et al., 1978; Terrace, 1966).

[21]The performance patterns of the retarded subjects fell between the two extremes. Follow-up training resulted in each child quickly learning to respond to the cues which had proved nonfunctional during discrimination training. Thus, no evidence was found to suggest a sensory modality failure--a conclusion supported elsewhere in the literature (e.g., Hermelin, 1976; Hermelin & Frith, 1971; Hermelin & O'Connor, 1970).

was the belief that social situations require, among other skills, the ability to make fine-grain discriminations among individuals on the basis of such critical features as attire, hair style, and voice pitch, if one is to act in a "socially appropriate" manner. So, a group of normal children and an autistic comparison group were taught to discriminate between lifelike male and female figures. Various aspects of the figures were then altered (viz., heads of the two figures were exchanged). Results of the study corroborate the selective attention hypothesis—namely that, of necessity, individuals attend only to a portion of available sensory input. However, in the case of autistic children in particular, a corollary was added to the hypothesis: Experimental results indicate that when exposed to a multiple-cue stimulus compound, autistic children are very likely to overselect to input; that is, they will often restrict their attention to such a limited number of the available cues that their performance becomes impaired. In the study just cited, for example, the normal children learned to discriminate male vs. female on the basis of heads. When the heads were exchanged, the normal subjects were then able to redirect their attention to another distinguishing attribute. Now the distinction between sexes was made on the basis of pants-for-males and dresses-for-females cues. On the other hand, the autistic youngsters locked onto such variable and irrelevant cues as color of shoes or style of shoes (Schreibman & Lovaas, 1973). One major implication of these findings bears directly on the overselectivity hypothesis: If the hypothesis is correct, selective attention that is exclusively and persistently directed to irrelevant features of individuals may help explain the inability of many autistic children to form stable personal

relationships (Lovaas et al., 1979). Further, the overselectivity phenomenon might also explain the use of such diagnostic descriptors as "cold," "withdrawn," or "severe affect isolation," that traditionally have been invoked to characterize the autistic child (Kanner, 1965; Ornitz & Rutter, 1976; Ritvo, 1976; Rutter, 1968).

Numerous investigations have confirmed and further extended the original findings of the Lovaas group. Briefly, overselective attention has been found to occur across modalities, as when auditory and visual senses are involved (Kovattana & Kramer, 1974; Lovaas & Schreibman, 1971). Overselectivity has been isolated within a given sensory modality, as in the case where the task includes three visual cues (Wilhelm & Lovaas, 1976), two visual cues (Koegel & Wilhelm, 1973), or auditory cues (Reynolds et al., 1974). In each case, subjects experienced difficulty with multiple-cue stimulus arrays, even when the cues existed within one sensory modality and regardless of whether the autistic child was verbal or not (Schover & Newsom, 1976). Finally, overselective attention has been found to characterize the perceptual patterns of some retarded (Wilhelm & Lovaas, 1976) and learning disabled (Bailey, 1981) children as well.

In light of the findings that have accumulated to date, it is clear that a distinction may be made between "selectors" (those who screen input sensory data for task-relevant features) and "overselectors" (those who screen sensory input, but tend to sift the data in some inappropriate fashion) (see Frankel et al., 1978; Koegel & Schreibman, 1974). Autistic children appear to overselectors: "When autistic children encounter multiple stimuli, only a restricted range of those

stimuli gain control of their behavior" (Lovaas & Newsom, 1976, p. 338). As Koegel and Wilhelm (1973) continue, "there have been no clearly identified stimuli which the children selectively avoid; there have been no clearly identified patterns of unresponsivity; and the failure to respond has not been linked to any other behavior characteristics of autism" (p. 443).

Clinical Remediation

Ray (1972) recently asked, "where is the conception of attention as something taught rather than something immutable to be measured" (p. 293)? As noted previously, Ross (1976) was even more explicit in asserting the importance of attention to instruction: "If one could discover techniques to teach (autistic) children the skill of attending to all relevant aspects of a stimulus in a learning situation, one would contribute significantly to their education" (p. 54).

Koegel et al. (1980) maintain that "the selective responding characteristics of many autistic children is a problem that is modifiable" (p. 277). The goal of remediation, to borrow from Miller and Dollard (1941), is to promote the "acquired distinctiveness of stimulus cues." To this end, several studies have been undertaken to investigate ways in which overselective attention could be remediated. Schreibman (1975), for example, extended the dissertation efforts of Koegel (1971) to remediate overselectivity. Koegel had found that while some autistic children were unable to make the cross-modality transfer from a color prompt to the training stimulus, they became highly skilled at perceiving fine grain discriminations along the prompt (i.e., color) dimension itself. Schreibman thus reasoned that a "within-dimension"

prompt might provide the added instructional guidance necessary for correct performance while at the same time avoiding the need for the overselective pupil to transfer dimensions (to switch from an external prompt back to the training cue). The research she conducted confirmed the hypothesis. By exaggerating the critical attributes of an object (i.e., the arm position of a stick figure), combined with the "fading-in" (Caron, 1968; Terrace, 1980) of the irrelevant attributes of the object (i.e., head and legs of the stick figure), Schreibman was able to teach a visually overselective autistic pupil to discriminate between two stick figures on the basis of arm position alone. When the traditional "extra-prompt" tactic was used (instructor pointing to the correct cue), however, the child was unable to make the transfer from prompt stimulus (teacher finger) to training stimulus (stick figure) required to make the discrimination. In sum, then, an instructional package of within-stimulus prompting + cue-enhancement (exaggeration of relevant task features) appears to be one proven approach to teaching children with visual overselective attention handicaps (e.g., Wolf & Cuvo, 1978).[22]

Koegel and Schreibman (1977) investigated an alternate strategy for remediating visual overselectivity clinically. Rather than addressing prompting and prompt-fading tactics, their approach consisted of teaching visually overselective autistic children the components of a

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[22]In several important ways, this clinical procedure is a logical extension of a number of earlier studies. To trace the empirical evolution of the procedure, the reader is referred to Gollin and Savoy, 1968; Lawrence, 1952; Lubker, 1967, 1969a,b; Moore and Goldiamond, 1964; Restle, 1955; Sidman and Stoddard, 1966; Terrace, 1963a,b, 1966; Touchette, 1968; and Wyckoff, 1952.

multi-stimulus task and then observing whether or not knowing the individual components would improve the discrimination performance of the subjects.[23] The compound in their study consisted of a single auditory cue (tape recorded noise) and a single visual cue (ceiling-mounted red light). A group of autistic children first were trained to respond to the presentation of each of the two single cues. Then, when criterion was reached on each of two single-cue tasks, the children were given three types of trials: auditory cue presented alone, visual cue alone, and the auditory plus visual cue compound. Results indicated that upon learning each of the cues in isolation the stimulus compound itself was acquired rapidly. In short, the autistic children were able to learn a compound stimulus once its critical components had been mastered individually.

In yet another approach to treating visual overselective attention clinically, Schreibman, Koegel, and Craig (1977) reported a study that linked overselective attention to repeated practice. Specifically, they found that repeated practice with a multiple cue compound resulted in a decrease in the overselectivity measure with 13 of 16 subjects screened for the presence of that learning handicap. Their findings support in part the research outcomes of other studies--namely, that repeated exposure to visual discrimination tasks alone correlates highly with a concomitant decrease in overselective attention (Frankel et al., 1978; cf. Hively, 1962; Schover & Newsom, 1976).

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[23] This approach likewise is linked directly to earlier research efforts, particularly Eimas, 1964, 1969; Houston, 1967; Slamecka, 1968; Ullman and Routh, 1971; and Underwood, 1963.

Overselective Attention: Instructional Intervention

Laboratory approaches to treating overselectivity have focused, then, on one or more of three strategies: (1) overtraining the task ("practice makes perfect"); (2) parts-to-whole instruction ("sum of the components equals the compound"); and/or (3) exaggeration of the critical features of a task ("within-prompting") plus the fading-in of irrelevant task cues. These treatment alternatives are noteworthy for at least two reasons. First, they represent promising first attempts to in some way bypass a little understood learning handicap--that of overselective attention. Second, the strategies address another of the functional variables associated with effective instruction. Specifically, rather than concentrating exclusively on the manipulation of behavioral consequences (viz., reinforcers, punishers), these studies looked at materials (task stimuli), instructions (teacher task requests), and prompts (teacher cues). This focus upon a more empirical validation of the overall instructional program "package" itself has been the subject of concern in recent applied research on educating autistic persons (e.g., Dunlap & Koegel, 1980; Lord & O'Neill, 1980; Lovaas & Newsom, 1976).

However promising the research, it is nonetheless difficult to attain a high degree of experimental rigor while still expecting the results to prove of practical benefit (Hartmann & Atkinson, 1973). In terms of remediation strategies, hardpressed practitioners have little time to implement research-based programs which are perceived to be

escessively costly in terms of teacher preparation, materials development, equipment demands, or even instructional time. Not surprisingly, then, there are several reasons why these clinical strategies fail to be of much applied value in classroom settings. First, many tasks simply are not amenable to cue-enhancement and/or stimulus fading. While it may be that in the classroom the child will encounter discrimination, matching-to-sample, or correspondence activities which the teacher can readily modify in order to engineer visual attention, most tasks typically will be too complex for that sort of dissection. A similar argument applies to one-behavior-at-a-time approaches to teaching complex tasks (e.g., Koegel & Schreibman, 1977). Again, for most classroom learning activities, parts-to-whole teaching tactics exact a level of time, effort, and programming concentration generally not attainable under everyday classroom conditions (Hartman, 1981). Second, time constraints placed upon teachers in light of administrative responsibilities created by PL 94-142 militate against this sort of piecemeal programming, however lofty the ideal (Brown et al., 1976; Hayes & Higgins, 1978). Third, increasingly there are calls to move away from the strict one-on-one instruction. Brown et al. (1978), for example, argue that small group instruction not only can still permit individualized instruction, but at the same time is far more economical in terms of teacher time. Small group instruction apparently can be effective, but apparently only if teachers are properly trained (Etzel & LeBlanc, 1979; Rincover & Koegel, 1977; Russo & Koegel, 1977).

Rincover and Koegel (1977) have stated that "there seems to be a

basic deficit in overselective responding in autistic children and there is as yet no research available attempting to remediate it" (p. 347; italics added). Given the investigations reviewed, however, that contention must now be modified. In short, the real problem facing the practitioner is the fact that none of the three clinical alternatives offers a remediation strategy that may readily be integrated into ongoing classroom instructional activities. Solutions are not presently available that incorporate the materials, tasks, and pupil-specific programming required by the current climate of "least restrictive" and "zero reject" placement policies. Yet, visual overselectivity remains a learning handicap "severe enough to retard or prevent learning" (Rincover & Koegel, 1977, p. 335). Hence, instructional approaches are needed which can improve upon the shortcomings of the clinical alternatives available at present.[24]

When striving to incrementally improve upon the delivery of instructional services to the handicapped, a standard of evaluation should probably be adopted by which to determine whether or not such improvement has not only been achieved, but whether the improvement is in fact worth modifying the status quo. In this regard, Kazdin (1980) has suggested that "acceptability" be considered as one such standard of worth. The main question, he argues, is whether or not, in the judgment of "potential consumers," the program is "fair and reasonable" (p. 259).

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[24] Dunlap and Koegel (1980) report a pilot study the procedures of which they conclude could be implemented in the classroom. However, the study essentially is an anecdotal description of a strategy whereby subjects were taught to verbalize cues associated with the task. Without a clear description of the design, experimental procedures, or outcomes, conclusions at best must remain tentative.

In turn, Occam's Razor provides a useful guide to conducting that evaluation. Occam's Razor is a maxim which, in its original form, cautioned that "it is vain to do with more what can be done with less" (in Russell, 1959, p. 162). Russell goes on to refine that wisdom by suggesting that "if a simple explanation will do, it is idle to seek a complex one" (pp. 162-163). Importantly, however, this principle of parsimony was not intended to mean that the simplest explanation for an event is necessarily always the same; rather, it is the "simplest explanation which covers all the circumstances" which should be the alternative of choice when making decisions (Burnam, 1975, p. 181). Relating the concept of parsimony to instruction, Etzel and LeBlanc (1979) conclude that "persons involved in teaching (autistic) children should seek the least complex but still effective procedure for changing behavior" (p. 362).

The purpose of this study was thus to investigate and compare the remediation effect on visual overselectivity of two instructional interventions. One intervention derived from perceptual-motor theory and attempted to train autistic subjects to use everyday objects (e.g., spoon and bowl) in a functionally-appropriate manner. The question raised was whether or not such an approach would sufficiently "hook" the child's attention to the critical features of the materials so that (s)he would be able subsequently to identify colored line drawings of the objects during a posttesting sequence. The second intervention addressed a stimulus shaping remediation strategy whereby another group of autistic subjects would be trained to match the same everyday objects to their color photograph and colored line drawing counterparts. Again a

similar question was asked: Would such an approach be effective in directing their attention to the distinguishing features of the objects such that colored line drawings of those objects later would be matched on a posttest?[25]

The proposed remediation programs would be parsimonious in several ways. First, as will be discussed, each reflects closely a large body of supporting literature. Little time and effort thus were wasted investigating strategies that lack empirical foundation. Second, the programs make use of materials which presumably are readily available in typical special education classrooms. No specialized equipment need be purchased nor materials significantly altered. Third, the approaches permit already existing materials to be used in perhaps instructionally novel and creative ways. Equivalence training activities, it will become apparent, can become an ongoing part of the classroom day, again using teacher time and preparation more efficiently. Finally, the approaches and their precepts are rather easily understood. Kerlinger (1979) has noted in this regard that "if we let explanations and reasons multiply, we end up with confusion, or with a situation so complex that we cannot really grasp it" (p. 180). That which is easily grasped may be more readily accepted, if proved effective.

In general, the twin interventions attempted to integrate the research implications from the literature reviewed in the areas of

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[25]A third group of children also were included in the study in order to test the the hypothesis that repeated practice with stimulus materials alone might be sufficient to remediate visual overselective attention (cf. Frankel et al., 1978; Schover & Newsom, 1976; Schreibman et al., 1977).

applied behavior analysis, operant conditioning, attention training, teaching autistic children, and perceptual-motor development. Hence, the study (a) focused on programming antecedent stimuli (structuring task materials, developing behavioral objectives and task sequences, and adopting trial-by-trial training procedures), (b) stressed the tactile and visual sensory modalities, (c) made use of materials typically found in the school or home, and (d) provided a structured environment that included behaviorally-trained tutors, minimum background distractors, and one-to-one tutor/pupil instruction.

Intervention I: Functional object-use Instruction

Rutter (1970), for one, has advocated greater exploration of perceptual-motor strategies for training autistic children, suggesting in particular that "the autistic child is likely to understand better what he is shown than what he is told" (p. 7; cf. Kolko et al., 1980). Similarly, Lovaas and Koegel (1973) have called for closer examination of a perceptual-motor intervention strategy as a possible approach to overcoming deficits in overselective attention, "since no systematic data have been put forth to evaluate it" (p. 236).

In terms of the development of perceptual-motor skills, however, autistic children seemingly fail to progress beyond the near receptor stage of sensory development. The research of Goldfarb (1956, 1964) and Schopler (1966), for example, has found that autistic children prefer "proximal receptor" tasks (involving touch, taste, and smell) to "distal receptor" tasks (involving seeing and hearing). Hermelin and O'Connor (1967) reported further that autistic children who participated in their study and failed to learn simple visual discriminations "did not seem to

'see' the figures on the stimulus card, though they did 'look' at them" (p. 459). Subsequent studies corroborate that "autistic children tend to touch, smell or lick things rather than look or listen" (Frith & Hermelin, 1969, p. 153; also Hermelin & O'Connor, 1970; O'Connor & Hermelin, 1967; Ornitz & Ritvo, 1978).

It may be, then, that in addition to problems of "advertising" saliency and "engineering" attention in program development, "receptor preference" itself is a contributing factor to handicaps related to selected attention (Rincover & Koegel, 1977). If so, autistic pupils would tend not to make the necessary sensory transition from a perceptual dependence on tactile and kinesthetic stimuli to the more developmentally advanced visual and auditory receptors (Goldfarb, 1956; Hermelin, 1976; Schopler, 1966). Without an instructional sequence designed specifically to program the shift from object manipulation ("functional object-use") to colored line drawings, autistic pupils might fail to identify pictures of the very materials being used (Stokes & Baer, 1977).

Rutter (1970) suggests in this regard that instruction too often risks the danger of "overloading the child with stimuli. It may thus be better initially to communicate in one sensory modality before providing links to others" (p. 7; also Kephart, 1971; Montessori, 1912, 1964). Consequently, one intervention of the present study focused upon deficits in "visual selective attention" (Hallahan et al., 1973). Accordingly, through the use of a "response shaping" program in which a group of pupils were taught to use certain everyday materials in a functionally appropriate fashion, perceptual-motor training strategies

attempted to remediate visual overselectivity. If initial findings prove encouraging, follow-up studies can direct applied research efforts to the other sensory modalities.

The primary rationale for this approach (and to some extent, for the second intervention as well) it should be noted, stems directly from perceptual-motor theory, particularly from the early works of Itard (1962), Seguin (1907), Montessori (1912), and Kephart (1971). If perceptual-motor development is based on sensory training as currently believed (e.g., Ball, 1971), then programs which reflect such a base owe an incalculable debt to Itard and his ingenious sensory training activities with a severely retarded child. Itard stressed tactile sensitivity activities as a precursor to developing the attending behaviors he rightly reasoned were critical to visual discrimination training (Itard, 1962, pp. 20, 27). From there he worked to teach his famous student "Victor" a series of matching-to-sample skills. The point, though, is not to review his approach to instructional programming, but to illustrate the process of facilitating perceptual development which Itard pioneered and further, to suggest that much of what is taken for granted today in training the handicapped (prompting tactics, modeling, imitation, task analysis, contingent reinforcement) unquestionably was introduced by Itard (1962: see, for example, pp. 14, 18, 32, 34, 35, 40).

From Itard's early work evolved more elaborate "sensory education" programs such as those typified by the work of Sequin (1907), Montessori

(1912), Kephart (1971), and Cratty (1970).[26] In particular, Montessori (1912, Chapters 12, 13) sets forth a program of "graded stimuli" which, with painstaking precision, progresses systematically from object recognition to pattern discrimination. As she advises, "the education of the senses has, as its aim, the refinement of the differential perception of stimuli by means of repeated exercises" (p. 173). Functional object manipulation, then, is the center of approaches which are faithful to the "Montessori method."

Bruner (1966) and others (e.g., Gibson, 1969; Piaget & Inhelder, 1969) maintain that purposeful object manipulation is important to object perception which is thought to precede the development and understanding of symbol systems (viz., language). This position appears to be partially supported in recent efforts to train receptive labeling with the severely handicapped (Bricker & Dennison, 1978; Bricker et al., 1976; cf. Janssen & Guess, 1978). Support for training object function as a precursor to visual discrimination (and hence as a precursor to remediating visual overselectivity) comes from Kephart's (1971) model of the "functional interdependence of tactual-kinesthetic and visual perceptual development." That model is predicated on the assumption that "perception and cognition...ultimately develop from a motor base" (Ball, 1971, p. 125ff). The Kephart model of perceptual development, not unlike other programs that have emerged from a similar developmental

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[26] Sensory training theory also owes a debt to Piaget. However, as Elkind (1967) put it, "for Piaget, the study of the child is really a means to an end rather than an end in itself....(Piaget) is not concerned with child-rearing practices, nor—at least until recently and only with reluctance—has he dealt with educational issues" (p. 536).

framework (e.g., Barsch, 1967, 1968; Cratty, 1970, 1979), strives to help the child "identify the appropriate S^{D}s from a confusing array of stimuli" (Ball, 1971, p. 142). In short, then, a functional object-use approach to learning is based on tenets of "sensory education" which long ago set the foundation for more recent instructional strategies aimed at teaching the relationship between sensory input and motor performance.[27] For example, functional practice with everyday objects alone might serve to highlight their critical dimensions and relevant attributes: Using a spoon and bowl in an appropriate manner might enable the visually overselective pupil to later match that cup to colored line drawings of the cup which otherwise might not be possible. In short, if it is true that there is practical utility in training children to "see with their hands" (Montessori, 1912, p. 190), then perhaps a specific perceptual-motor training procedure could be designed to highlight, to advertise, object features such that handicapped learners would recognize those "bundles of features" when encountered in the sort of

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[27]The extent to which much of the later research on attention and discrimination training is indebted to these several individuals may be appreciated by referring to Ayres (1973), Ball (1971), Edgar et al. (1969), Elkind (1967), Gibson (1969), and Lerner (1976). Rather surprisingly, however, the contributions of these pioneers seem to have gathered neglect with the passage of time and the accretion of contemporary applied studies. In truth, part of that oversight may relate to the controversy that continues to surround more recent efforts to link perceptual-motor training to academic gains (see Lerner, 1976; Salvia & Ysseldyke, 1978 for discussion). At any rate, perceptual-motor programs developed for normal and for handicapped children are numerous. The interested reader is referred to the following for a partial review: Bachrach et al. (1978), Baird and Goldie (1979), Barsch (1967, 1968), Bartak (1978), Callias (1978), Clark and Shuer (1978), Cratty (1979), Curcio (1978), Fernald (1943), Frostig and Maslow (1973), Getman (1965), Lorimer (1977), Morrison and Pothier (1972), Singer (1977), Webb (1969), Webb and Koller (1979), Westling and Koorland (1979).

colored line drawings contained in pre-primer picture books.

Intervention II: Equivalence training Instruction

In contrast to a functional object-use strategy based on perceptual-motor theory that links object manipulation to improved perception, there is a wide body of literature that supports a training program designed to systematically transfer perception from objects to their symbols (photographs, line drawings, words, etc.). Accordingly, the second intervention attempted to program this "perceptual leap" from objects to colored line drawings of those objects. Relevant to such a strategy, Mussen et al. (1974) have argued that "if the child learns the distinctive features of an object, he should be able to recognize a schematic picture of a familiar object even though he has had no previous contact with pictures" (p. 283). Gibson (1969) for one is more cautious in her conclusions regarding the transition from object to pattern perception. For her, there are several propositions which may affect object-to-form transition, including: degree of perceptual differences between stimuli; extent to which those differences are emphasized during instruction; whether or not the differences are exaggerated during instruction (e.g., Schreibman, 1975); whether or not new objects being trained are part of and similar to a set of objects already possessing familiar features; and whether examples of contrasts along some dimension (e.g., size, shape, color) of the object are provided. As Gibson concludes, "when moving from objects to patterns, there is a profound difference between (those pictures) and the objects pictured" (p. 396).

There is a rather rich history of attempts to program--to

systematically facilitate—the transition from object perception to pattern perception.[28] Lawrence (1949, 1950), for example, found it easier to train a two-choice visual discrimination when objects were trained before patterns. As he put it, a "difficult discrimination is more easily established if subjects first are trained on an easy discrimination of the same type than if all the training is given directly on the more difficult discrimination" (1952, p. 511). The transition from easy to hard discriminations "involves a number of gradual steps rather than occurring abruptly" (1955, p. 37; also Restle, 1955; Wyckoff, 1952). Later, though working with pigeons, Terrace (1963a,b, 1966) showed that by a combination of fading plus superimposition, discrimination transfer could be acquired virtually without error. Subsequent efforts with normal (e.g., Moore & Goldiamond, 1964), retarded (e.g., Sidman & Stoddard, 1966, 1967; Touchette, 1968), and autistic (Rincover, 1978) youngsters with this approach documents further that systematically programming visual perception (beginning with objects and moving on to pictures and then other symbol systems) can permit discrimination learning with a minimum of errors.[29] Indeed, in more recent times, several programs for the handicapped have drawn on this literature and initiated language training efforts, for example,

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[28]The technical terminology used to identify and study these stimulus-shift procedures is "inter-dimensional shift" (see Estes, 1970; Lubker, 1967, 1969a,b; Stevenson, 1972).

[29]The classic work of Terrace and his followers (e.g., Moore & Goldiamond, 1964; Sidman & Stoddard, 1966; Touchette, 1968) has been characterized as "errorless learning paradigms." However, in the discrimination literature as it addresses human learning, such paradigms have not prevented errorful responses from occurring; thus, perhaps a more appropriate term would be "minimal error learning."

with some variant of pictorial instruction (e.g., Dixon, 1981; Murphy et al., 1977; Spellman et al., 1978; Vanderheiden et al., 1976).

Based on the literature in the areas of stimulus fading, errorless learning, and stimulus transfer, this study thus investigated the feasibility of implementing a variation of such a program--an instructional package that would emphasize "graduated contrasts" among training stimuli (Gibson, 1969, p. 99). The training package consisted of the following four-step sequence. Initially, subjects were trained to match two sets of real objects typically found in the classroom and/or home environment. Next, the subjects were taught to match color photographs of the objects to the same objects. (It was assumed, in view of the literature, that this second step would prove marginally more difficult perceptually, since the patterns (photographs) presumably would drop some of the stimulus characteristics of their real object counterparts.) The third step in the program consisted of teaching the youngsters to match two sets of photographs of the same objects, with the final step consisting of matching those color photographs to their colored line drawing counterparts.[30]

The study also looked at one other strategy associated with the remediation of visual overselective attention. Returning again to the work of Gibson (1969), "visual discrimination and recognition have been shown to improve with practice without benefit of correction" (p. 139).

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[30]This four-step instructional package is not altogether new. Gibson (1969, pp. 102-103) reviews the work of Ryan and Schwartz (1956) along with several French investigations during the early 1960s which provided the framework for the strategy herein described.

Perhaps in response to Gibson's (1969) proposition, Schover and Newsom (1976) and Schreibman et al. (1977) investigated the possible link between visual overselectivity and repeated practice and found that for some of the experimental subjects, there was a decrease on the overselectivity measure as a result of repeated practice with the discrimination task. Accordingly, the present research attempted to replicate those findings by exposing a group of visually overselective autistic youngsters to a condition which consisted of a series of unreinforced practice trials on the test tasks.

Research Questions

The two interventions attempted to answer the following two questions:

1. Will an equivalence training or will a functional object-use training intervention result in greater reduction in the degree of visual overselectivity?

2. Will either of the two interventions prove more effective in reducing overselectivity than a comparison condition which involves repeated practice with the test materials?

Chapter 3

METHOD

Setting

The study was conducted at the Suffolk Child Development Center (SCDC) located on Long Island, New York, some 60 miles east of New York City. SCDC is a private, multidisciplinary non-residential school for autistic and emotionally disturbed children, ages two to twenty-one. Licensed by the New York State Department of Education, SCDC operates educational and research programs at three locations on Long Island, with its main center situated in Smithtown. The research reported herein was carried out at two of those sites—at its main center in Smithtown and at the site located on the south campus of the State University of New York at Stony Brook.

Subjects

Fifty-seven school-age children comprised the experimental pool and had been diagnosed as autistic by SCDC staff prior to initiation of the study. The diagnostic criteria used to describe "autism" were consistent with the criteria established by the American Psychiatric Association (APA, DSM-III, 1980), the descriptions updated by Rutter (1978) and Newsom et al.(1980), and with PL 94-142, as amended.

The experimental subjects were drawn from a pool of some 150 children that included both males and females with a CA range of 3-0 to 16-3 and IQ scores that ranged from an 20 to 87 (see Table 1). All

children were from middle class families, with about 20% of minority (Black and Hispanic) background. All lived within a 40 mile radius of the Smithtown and Stony Brook training sites.

Instrumentation

Dependent variable

The dependent variable in the study was an index of visual overselectivity.

Independent variable

The independent variable in the study was instructional treatment of which there were two levels: (1) a Perceptual-motor intervention that emphasized functional object-use training (Treatment 1); and (2) a Perceptual-saliency intervention that emphasized equivalence training (Treatment 2). A third group of subjects served as the comparison condition and were exposed to repeated practice exercise ("drill and practice") with the test materials.

Inter-rater reliability

Kazdin (1977) defines reliability as "agreement between observers who independently score the same behavior of a subject" (p. 141). He points out that given the variation in testing and training settings (such as the inconsistency of subject performance across days, differential training required with low functioning children), precautions should be taken to ensure that target behaviors are recorded accurately and that observers agree on precisely what it is that is

Table 1

Subject Characteristics

EQUIVALENCE Group

Code #	SEX	IQ	CA
E1	M	20	13-2
E2	M	47	7-6
E3	F	20	6-11
E4	M	24	10-0
E5	M	87	4-5
E6	M	24	11-11
E7	F	43	13-2
E8	M	84	3-7
		$\overline{X}$=47.00	$\overline{X}$=8-7
		$\overline{SD}$=26.69	$\overline{SD}$=3-7

FUNCTIONAL OBJECT-USE Group

Code #	SEX	IQ	CA
F1	M	47	7-7
F2	M	46	15-9
F3	M	22	10-3
F4	M	35	5-10
F5	M	33	16-3
F6	M	80	3-7
F7	M	*n/a	14-5
F8	M	49	7-6
		$\overline{X}$=44.57	$\overline{X}$=10-0
		$\overline{SD}$=18.33	$\overline{SD}$=4-8

Comparison Group

Code #	SEX	IQ	CA
C1	M	39	10-5
C2	F	22	14-5
C3	F	73	13-1
C4	M	37	8-5
C5	M	42	3-0
		$\overline{X}$=42.75	$\overline{X}$=11-6
		$\overline{SD}$=21.54	$\overline{SD}$=2-8

*n/a = not available

being measured. While there has been considerable controversy of late concerning alternative formats and calculations which might be considered in presenting observer agreement data (e.g., Berk, 1979; Harris & Lahey, 1978; Hartmann, 1977; Kent et al., 1977; Kratochwill & Wetzel, 1977), the following conventions were adopted for purposes of this study.

Personnel not associated with the study were trained and used periodically as observers to independently record subject responses during all phases of the study. An agreement was scored when the observer counted a particular trial in a manner identical to that of the trainer. Specifically, referring to the data forms in Appendix D, both scorers would thus have to score a given trial identically by putting a ✓in the appropriate column (see page 76). Reliability then was calculated on a trial-by-trial basis using the standard formula, number of agreements divided by number of agreements plus disagreements times 100. Reliability checks were conducted at least twice during the pretest and posttest phases and once during the intervention phase. At all times the trainer was unable to see the scoring sheet used by the reliability checker during the probes.

Each data-collector who participated in the study first was trained by the experimenter to (a) administer the pretraining, training, and testing procedures, (b) use the data collection and data summary forms as designed and required for the study, and (c) conduct one or more of the three experimental conditions. Training consisted of first observing the experimenter demonstrate correct behaviors associated with each experimental phase (e.g., materials display, task presentation,

reinforcement, data recording procedures, etc). After observing the correct training, testing, and intervention procedures, each data-collector was given supervised practice with the experimental procedures. Throughout, practice trials were monitored by the experimenter and on-site behavioral psychologist, with feedback and correction provided as necessary until the data-collector demonstrated familiarity and proficiency with all experimental procedures (Koegel et al., 1977). Periodic follow-up observations of data-collector behavior were conducted through use of a one-way mirror located in the experimental room.

Second, to further aid inter-observer reliability, a layout of correct training and testing stimulus displays was attached to the wall facing the data-collector. In addition, a task analysis of the steps the trainer should follow during the training, testing, and intervention phases was posted in the experimental room. Each week an updated computer-generated printout of the training/testing/intervention status of each S also was taped to the wall. That printout contained a record of (a) each subject selected for the study, (b) room number and name of each child's classroom teacher, (c) whether or not parental permission to include the children the study had been received, (d) where the subject was located along the experimental continuum (pretraining, pretesting, intervention, posttesting), and (e) special instructions the trainer(s) should follow (e.g., edibles the child may or may not have; pica behaviors to monitor; tactile defensive reactions the child may exhibit; motor impairments that might affect response topographies, etc.)

Experimental Procedures

The study was conducted in four phases; those phases were pretraining, pretesting, instructional intervention, and posttesting.[31]

Phase I: Pretraining

Testing for the presence of visual overselectivity was conducted in two steps. The first step consisted of pretraining each candidate on the prerequisite match-to-sample task. During the second step—pretesting—novel cards were inserted into the match-to-sample training sequence to probe for the presence of visual overselectivity. Fifty-seven candidates participated in the pretraining phase of the study.[32]

Pretraining stimuli. The pretraining stimuli for the study were colored line drawings of common objects drawn by a public school art teacher. All pictures were drawn in perspective (e.g., having depth, angles, etc.), were the same size (6 x 8 cm), and fit within the same size border (17.5 x 12.5 cm). All stimulus drawings consisted of

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[31]Appendix G presents a series of flowcharts which may be useful in tracking the experimental phases of the study.

[32]At the time of the study, SCDC served some 150 youngsters diagnosed as autistic/emotionally disturbed. Of that population, 60 children were selected for pretraining on the basis of diagnostic purity (meeting the screening criteria for "autism") and functioning level (having the prerequisite behaviors). Of those 60, parent/guardian consent forms were obtained for 57.

two-component compounds related in a functionally appropriate and obvious manner and colored to approximately match the three-dimensional object represented. (See Appendix A for a scaled-down, black-and-white representation of the three sets of stimuli used during pretraining.)

Pretraining sequence. The pretraining procedures employed were derived from earlier research in overselectivity (viz., Koegel & Wilhelm, 1973; Kovattana & Kramer, 1974; Lovaas et al., 1971; Schover & Newsom, 1976). However, such studies typically have used what are called simple simultaneous visual discrimination paradigms, whereby "discriminative stimuli have an invariant relation to reinforcement and extinction; thus, the presentation of S^D is an occasion for reinforcement of the specified response, while the presentation of S^Δ is an occasion for some other behavior" (Cumming & Berryman, 1965, p. 285).[33] Bryson (1970) has found, however, that when working with autistic children, the use of these discrimination procedures often results in lower levels of performance than might occur with the match-to-sample procedure, the difference being related to "the memory factor inherent in the discrimination training method" (p. 244; also Litrownik et al.,

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[33]Technically, the study was based on two experimental paradigms previously used in similar visual discrimination research. First, the training task involved a "redundant relevant-cue-discrimination" paradigm. "Relevant" refers to the cue which is correlated with reinforcement, "redundant cue" conveys the fact that the subject can respond correctly (relevantly) by attending to either of two stimulus cues contained in the problem (see Trabasso & Bower, 1968, pp. 18-19 for further discussion of the paradigm). Second, the conditional discrimination procedure incorporated a variation of the "Hagen central-incidental visual learning paradigm" (see Day, 1980; Drucker & Hagen, 1969; Hale & Alderman, 1978). In such a procedure, Ss are presented with an array of stimulus card pairs, instructed to remember them, are later presented with various combinations of the pairs and asked to identify the stimulus cards which go together.

1978). Accordingly, to minimize the effect of retention as a possible experimental confound, the present study adopted a simultaneous match-to-sample ("conditional discrimination") training technique (Lashley, 1938). With this more complex discrimination training procedure, "the correct response cannot be made solely on the basis of a single stimulus, but must be based on the properties of two or more stimuli" (Cumming & Berryman, 1965, p. 285).

Prior to initial testing for the presence of visual overselectivity, each student (S) thus was taught to match a sample picture stimulus to its duplicate located within an array of three cards placed on the table in front of him/her (see diagram below). In addition to the duplicate, two "distractor" cards (hat/doll, pot/stove) were presented on all trials except test trials. "Matching behavior" was defined by S reaching for and grasping the sample stimulus card held up by the experimenter (E) and then placing that card on its duplicate located within the three card array.[34] A total of three separate pretraining tasks (and thus stimulus sets) were used with each S.

Each S was individually pretrained (and subsequently tested) in a small (4 x 1.5 m) room located in the school building the child attended (see Appendix C for a sketch of the training/testing setting). At the beginning of each session S was seated at a table (60 x 45 cm) facing E. E began the training session by placing in front of S the sample stimulus compound (e.g., spoon/bowl). Below the sample stimulus card

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[34]The sample compounds and distractor comparison compounds used with each of the three pretraining stimulus sets are presented in Appendix A.

three comparison stimuli (e.g., spoon/bowl, hat/doll, pot/stove) were placed in a row. Spacing of the cards was kept relatively constant to maintain minimum separation among the stimuli (Rincover, 1978; Schreibman, 1975). E held up the sample stimulus card directly within the line of sight of S and said "Put same with same" (see diagram below; for convenience, word symbols have been substituted for the actual colored line drawings).[35]

Spoon
Bowl

Spoon
Bowl

Hat
Doll

Pot
Stove

If S matched the "correct" cards, E immediately said "Good boy (girl)," patted or stroked the child's hand or arm, and offered S an edible from a reinforcement menu that included vanilla wafers, Nabisco-brand "animal crackers" and "cheese nips," raisinettes,

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[35]Two points should be made with regard to these procedures: (1) It was assumed that each S would look at the trainer and the stimuli on request (e.g., "Michael, look at me."). Further, each S must have possessed sufficient vision and motor coordination to attend to and carry out task requests associated with the training, testing, and intervention procedures. This second assumption was important in order to avoid the possibility of experimental outcomes being confounded by gross sensorimotor impairment. Given the literature on the functioning level of young children with autistic-like behavior (e.g., Carr, 1976; Hermelin & Frith, 1971; Koegel et al., 1980; Newsom, 1980) as well as the degree of difficulty of the tasks involved, these skill prerequisites were warranted. (2) The decision to use the task request described was based on a considerable body of receptive language research which advocates (a) use of a minimum number of words with low-functioning pupils, and (b) emphasis upon the use of pivot or "starter" words (see Bricker et al., 1976; Guess et al., 1977; Sailor et al., 1980; Tawney, 1979).

pretzels, candy corn, popcorn, and flavored water. (Whenever possible, menu items contained no preservatives nor artificial coloring or flavoring.)

If S matched the "wrong" card, typical error correction procedures were invoked (e.g., Grimes, 1981a). That is, E said "No!" and then prompted the correct response (e.g., pointed to the correct card and/or physically guided S's hand to the proper card). The prompted response was then reinforced with verbal praise, plus a pat or stroke on the arm or hand. Edibles which S was allowed to select from the reinforcement menu were made available only during training trials in which S correctly matched the sample to its duplicate in the array of cards. For prompted responses, social rewards alone were provided.

If S failed to respond to the task request, E prompted the correct response and reinforced it verbally. All trials were separated by an intertrial interval of at least five seconds (Koegel et al., 1980) and trials were repeated in instances where the task was interrupted through no fault of S (e.g., E dropping a card, cards arranged incorrectly, another individual entering room, etc.).[36]

Each trial thus began with a task request issued by the trainer and ended with S making the correct matching response. Only unprompted matches were scored as correct responses. At no time was S reinforced for merely touching a portion of a comparison card; rather,

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[36]The operant-based training procedures described closely parallel those which empirically have been found helpful to practitioners teaching autistic pupils (Koegel, 1981; Koegel & Egel, 1979; Koegel & Rincover, 1976; Koegel et al., 1977; Sailor et al., 1980).

reinforcement was provided at the end of each trial in which S placed the sample card on its duplicate.

Pretraining continued until one of two conditions was met: (1) S failed to learn the match-to-sample task (viz., was unable to match the sample and comparison cards correctly on five consecutive trials within 300 trials); in such cases, (s)he was eliminated as a candidate for the study. (2) S satisfied the pretraining criterion (viz., five consecutively correct matches within 300 trials), thus indicating proficiency on the prerequisite match-to-sample task.[37]

When S was able to make five consecutive correct matches on a CRF schedule, reinforcement was shifted from a continuous to a variable ratio (VR:3) schedule in order to control for possible "reinforcement effects" found to influence overselectivity measures (Egel, 1980, 1981; Koegel et al., 1979). The pretraining phase then continued until S met the criterion of five out of five consecutively correct matches on the partial reinforcement schedule. The same prompting and/or reinforcement procedures remained in effect throughout the pretraining, pretesting, and posttesting phases of the study.

Phase II: Pretesting -- Visual Overselectivity Assessment

Pretesting was conducted using a "fractionation" test procedure in conjunction with the simultaneous match-to-sample paradigm (Jenkins, 1963; Jenkins & Sainsbury, 1963). Accordingly, two comparison cards, each bearing one of the two components that comprise the sample compound

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[37]Three candidates of the 57 failed to meet this criterion.

stimulus, were interspersed with the training cards on a VR:3 schedule during pretesting.[38] Thus, if the training task involved the "spoon/bowl" compound as the sample, each test trial included a card showing either the spoon component or the bowl component (along with the distractor cards) (see Appendix B).

Pretesting stimuli. The pretesting stimuli for the study likewise were colored line drawings of single functional-use objects. A total of three test tasks were administered to each S (Appendix B). Each of the three test tasks selected corresponded to a given "pinpoint" implied by developmental stage theory (Cohen et al., 1975; Ginsburg & Opper, 1978; White & Haring, 1978b). Thus, the "spoon/bowl" task was used to represent one self-feeding skill, the "foot/shoe" task as a self-dressing skill, and the "crayon/drawing paper" task as a pre-academic skill (Tawney, 1979).

The task for S during testing was to match the sample compound with the particular component displayed on a given trial. Hence, S had to match a sample compound stimulus with one of its components on 50% of the test trials, and match the sample compound with the other component the remaining 50% of the test trials.

Pretesting sequence. Table 2 presents all three sample compounds,

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[38] Testing trials were embedded within the training sequence rather than administered at the conclusion of a series of training trials in order to ensure that Ss maintained correct match-to-sample discrimination behavior. During testing, then, training trials may be conceptualized as behavior-maintenance trials.

their components, and associated distractor stimuli used in the study.[39] Table 3 presents the training and testing sequence for the "spoon/bowl" task using the fractionation testing model described above. Table 4 presents the configuration of stimuli for training and pretesting the "spoon/bowl" task as an example. Again, the sample compound was trained initially with two distractors. Then, one component of that same compound was tested, using distractors which were similar in shape and color (e.g., gray fork used as a distractor for gray spoon). Continuing with the "spoon/bowl" example, on 50% of trials the arrangement of colored line drawings during testing included a gray spoon, gray fork, and yellow plate on 50% of the test trials, and a yellow bowl, gray fork, and gray plate on the remaining 50% of test trials. The task facing the subject was to match the spoon/bowl compound to the spoon (when displayed) and to match the spoon/bowl compound to the bowl (when displayed).

Eighteen trials were administered in which each of the components was the correct choice ("spoon only" OR "bowl only"), resulting in a total of 36 test trials per task. The pretest comparison cards were inserted into the ongoing trial-by-trial instructional sequence on a variable ratio schedule of 3 (VR:3), thus resulting in a total of 108

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[39]Again, refer to Appendix A for the training configuration and Appendix B for the testing configuration of stimuli associated with each of the three test tasks.

Table 2

Training and testing stimuli used in overselectivity assessment

Task #	Sample Compound	Comparison Components	Distractor Components
1	spoon/bowl	spoon, bowl	fork-plate
2	foot/shoe	foot, shoe	hand-mitten
3	crayon/drawing paper	crayon, drawing paper	pen-writing paper

Table 3

Fractionation Training/Testing Sequence
(using "spoon/bowl" test task as example)

Step #	S^D (sample)	S^Δ (distractor)	Function of step
1	spoon/bowl	hat-doll pot-stove	To train both the spoon and bowl components together
2	spoon	fork-plate	To test spoon component alone
3	bowl	fork-plate	To test bowl component alone

Table 4

"Spoon/Bowl" Training, Pretesting/Posttesting Displays

Training configuration: "Spoon/Bowl" compound

	Spoon Bowl	
Spoon Bowl	Hat Doll	Pot Stove

Testing configuration A ("Spoon-only" trials): 50% (18) of test trials

	Spoon Bowl	
Spoon	Fork	Plate

Testing configuration B ("Bowl-only" trials): 50% (18) of test trials

	Spoon Bowl	
Bowl	Fork	Plate

(All three training/testing displays may be found in Appendices A and B.)

(training plus pretesting) trials per S per task.[40] A total of three training/pretesting test tasks were conducted with each S, with each task being pretrained to the five-in-a-row VR:3 criterion before pretesting was initiated.

In order to avoid influencing S's response patterns during the training/testing procedures, several precautions were taken. First, all drawings of the objects were about the same size. Second, in order to control for "location cues," position of the cards on the table were rotated across trials (after Gellerman, 1933). Third, color of the stimuli on two of the three tasks was controlled so that S would not be able to respond correctly on the basis of color alone. That is, in the case of the spoon/bowl task for instance, the spoon and fork were the same color (gray) with the bowl and plate being the same color (dull, dark yellow). Hence, S had to attend to the materials and then discriminate fork from spoon and plate from bowl on the basis of critical attribute (e.g., shape, depth) rather than on the basis of color. (On the third task [crayon/drawing paper], color was not controlled so that it could be investigated systematically as a possible confound.) Fourth, given the "marked inconsistency" with which autistic children typically respond, each S was exposed to several trials with each of the three test tasks during each session. This method of

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[40] In summary, a total of 108 trials were conducted for each of the 3 tasks. Of the 108 total trials, 36 were test trials of which 18 included component 'A' of the compound (e.g., spoon) and 18 included component 'B' (e.g., bowl). For each of the 18 "sub-trials," 6 displayed the component (e.g., spoon) on the left of the 3-card set, 6 in the middle of the set, and 6 sub-trials on the right. The remaining 72 trials (108 minus 36) were training trials which were presented, on average, every third trial (see sample data forms, Appendix D).

"stimulus rotation" (Carr et al., 1978) was implemented in an effort to minimize "boredom" during pretesting (and posttesting) (Dunlap & Koegel, 1980). Similarly, each session lasted at most 30 minutes in order to minimize fatigue factors. No more than two sessions were held on any one day. Finally, no consequences (reinforcement, correction) were provided to Ss on test trials.

Overselectivity criterion. The pretest overselectivity screen was conjunctive and conditional.[41] That is, S was required to satisfy two performance criteria during pretesting to be included in the study. Those criteria were: (a) to match one component (e.g., spoon) correctly on 9 or more of the 18 trials that it was available and (b) to match correctly the other component (e.g., bowl) enough times so that the difference between the two components would be at least 6. S thus was considered overselective on the component selected on 9 or more of the 18 trials (if, again, the other component was selected such that a "minimum-6-difference" existed between the two components). The same conjunctive criteria applied to the "foot/shoe" and "crayon/drawing paper" test tasks as well. The conjunctive, conditional criteria, however, applied only to the pretest scores, since only those data were used as an assessment measure for subsequent subject selection and assignment purposes.

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[41] With few exceptions (e.g., Meisel, 1981; Schreibman et al., 1977), overselectivity research has been lax in defining precisely the measurement parameters used to empirically distinguish overselectors from "other" selectors. Often, if the subject selected one component more than another, that difference alone was accepted as presumptive of overselectivity. In contrast, this study set a more rigorous criterion which, hopefully, would leave little doubt that the handicap was in evidence.

As an example of one application of the dual overselectivity criteria, suppose that on the "spoon/bowl" test task S matched the spoon/bowl compound with the spoon component on 9 or more of the 18 "spoon-only" trials and matched the spoon/bowl with the bowl with an at-least-6 difference on "bowl-only" trials. According to the conjunctive criteria, S would be considered visually overselective on the spoon component of the compound. Alternatively, were S to match the bowl/spoon compound with the bowl on 9 or more of the 18 "bowl" trials and also match the bowl/spoon with the spoon component with a "minimum-6-difference" on "spoon" trials, S would be considered visually overselective on the bowl component.

Overselectivity assessment. As Table 5 illustrates, the summary measures that emerge from an analysis of the pretest data consist of the following three scores: (a) a "component score" for each (component 'A', component 'B') of the two components (e.g., spoon; bowl) of a given stimulus compound (e.g., spoon/bowl). For the three tasks there thus would be a total of six "component scores" (spoon, bowl; foot, shoe; crayon, drawing paper); (b) a "compound score" for each of the three compounds (spoon/bowl, foot/shoe, crayon/drawing paper); and (c) a "conjunctive overselectivity test" (COST) index which combines into a single coefficient the compound scores obtained on all three pretest tasks.[42] The index thus indicates the extent to which S was

[42]Again, the COST index applies only to pretest data, since posttest scores did not incorporate the conjunctive/conditional screening criterion.

Table 5

Hypothetical Conjunctive Selection Ratios and Scores

Inclusion Criteria

Overselective on component 'A'	Component 'A' selected on 9 or more trials	Minimum-6-difference between 'A' and 'B'
Overselective on component 'B'	Minimum-6-difference between 'A' and 'B'	Component 'B' selected on 9 or more trials

TEST 1		TEST 2		TEST 3		"COST" Index
'A' Spoon component	'B' Bowl component	'A' Crayon component	'B' Paper component	'A' Foot component	'B' Shoe component	
18/18	0/18	18/18	0/18	0/18	18/18	54.0 (max)
9/18	3/18	9/18	3/18	0/18	0/18	12.0 (min)
12/18	18/18	12/18	18/18	12/18	18/18	18.0
6/18	12/18	6/18	18/18	12/18	18/18	24.0

overselective on the pretest relative to the test group.[43] Of the 57 candidates tested for the study, 21 were successful in satisfying the conjunctive, conditional criteria.

Data collection. Pretest (and posttest) data were entered on three forms, one for each task (see Appendix D). Each data form defined, a) which trials were training trials, b) which trials were test trials, c) in which position the training compound or test component must appear in the match-to-sample array, d) which trials should include a given test stimulus (e.g., spoon or bowl), e) the total number of both training and pretesting trials to be conducted, and f) the order in which both kinds of trials were to be administered. In addition, each form provided a record of which trials required prompting (labeled "P"), which trials S completed correctly and without prompting (labeled "C"), and on which trials the subject made an incorrect choice (labeled "I").[44] All data were summarized at the end of each experimental session and then entered and stored on disk for subsequent analysis, using the DECSystem-2060 computer support services at Columbia University.

Data example. An S who scored 1 out of 18 correct matches on the

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[43]See Appendix H for a logical task analysis of the computational methods use to calculate each of the scoring measures associated with the study.

[44]The "I" column on the data form was relevant on training trials only, during which independent and prompted responses were monitored. During testing trials, S in no way was ever prompted or otherwise cued to the correct choice. If S made an incorrect match during a test trial, the incorrect decision simply was 'checked' in the appropriate data form column. Only during training trials were S's responses prompted or rewarded.

'spoon-only' component pretest trials and 18 out of 18 correct matches on the 'bowl-only' component pretest trials would receive a "component score" of 1/18 for the 'spoon-only' test and an 18/18 "component score" for the 'bowl-only' test task. The overall "compound score" for the spoon/bowl task would be obtained by subtracting the two numerators of the fractions (18 - 1 = 17). If S then completed the remaining two test tasks and earned a compound score of 16 (17/18 - 1/18) on task number two and 15 (15/18 - 0/18) on the third task (crayon/drawing paper), the conjunctive overselectivity test (COST) index would be 48.0 (viz., 17 + 16 + 15).[45]

Phase III: Experimental conditions

The third phase of the study consisted of three experimental conditions. Recent applied studies with autistic learners indicate that overselectivity may vary with stimuli presented (Koegel & Lovaas, 1978; Litrownik & McInnis, in press). Hence, Ss were selected for participation in the study on the basis of meeting the dual screening criteria on at least 2 of the 3 test tasks described above. Ss who met this final screening requirement were then randomly assigned to one of the following three conditions: (1) Functional object-use instruction, (2) Equivalence-training instruction, and (3) Repeated practice exposure (the comparison group for the study). Each condition lasted an equal number of trials (100).

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[45]Again, of a possible total population of some 150 autistic children, 60 were selected on the basis of diagnostic purity and functioning level. Of that 60, parent/guardian consent forms were obtained for 57. Three children of that 57 were unable to acquire the pretraining match-to-sample behavior within 300 trials.

Condition 1: Functional object-use intervention. Based on perceptual-motor theory, one group of Ss received functional-use instruction with those objects pictured on the pretesting stimulus cards. A series of 100 trials were administered to each S in which each of the training stimuli (spoon/bowl, foot/shoe, crayon/drawing paper) was used in a functionally appropriate manner (viz., spooning sand, small pebbles, and a soft-drink powder from a bowl; putting a doll's shoe on its foot; making marks of some sort on paper with a red crayon).[46] Each trial began with E instructing S to engage in the functional-use task (e.g., "Spoon the (sand) out of the bowl, Jimmy"). A trial ended when S independently or with prompting (verbal cue, demonstration, physical guidance) manipulated the material in a manner appropriate to its intended function. Instances of inappropriate use of the material was corrected ("No!" plus demonstration and/or physical guidance), and proper use reinforced. (See Appendix F for the behavioral objective and logical task analysis associated with each task.)

Condition 2: Equivalence-training intervention. Based on perceptual-saliency theory, the second group of randomly assigned Ss received equivalence training. Instruction consisted of matching pairs of objects and/or patterns and progressed through four steps: (1) object-to-object matching, (2) object-to-color photograph matching, (3)

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[46]The three materials used in the spoon/bowl task were chosen for texture (sand), sound (large pebbles banging into bowl), and smell (sweetness of powder). Together with the red crayon (increased saliency), and shoe-onto-foot (complex motor task), the materials were selected in an effort to minimize problems with fatigue and boredom. All play materials where purchased at a "Child World" or "Toys R Us" retail store.

photograph-to-photograph matching, and (4) photograph-to-colored line-drawing matching. Each phase consisted of twenty trials which, when combined with an additional twenty warmup trials, resulted in a total of one hundred training trials for each of the four phases.[47] The same training procedures were followed during each of the four steps of this condition as were in effect during the training and functional object-use conditions. Also, as before, in all steps a training trial was defined to include instances in which S might have to be physically guided through the match-to-sample behavior chain.

Step 1: Equivalence training I (Object-to-object). Each S was presented with a set of three objects, one of which was the training object (e.g., spoon/bowl) and two of which were irrelevant ("distractor") objects (hat/doll, pot/stove). Twenty trials were administered in which S was taught to place the sample object beside its match within the array in response to the task request, "Johnny, put same with same."

Step 2: Equivalence training II (Object-to-color photograph). S was presented with a set of three colored photographs, two of which depicted the distractor objects and one which pictured the training object (e.g., spoon/bowl). S was given twenty trials in which (s)he was taught to match the training object to its picture counterpart.

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[47]The twenty warmup trials were provided at the start of each posttest session. Pilot work indicated that posttesting involved a total of three 20-30 minute sessions. Since the first posttest session immediately followed training, each of the other two test sessions thus required ten trials of warmup training.

Step 3: Equivalence training III (Color photograph-to-color photograph). S was presented with an array of three color photographs, one which depicted the training object and two which depicted the distractor objects. Again, S was given twenty trials in which the photograph of the training object (e.g., spoon/bowl) was matched with a color photograph of its counterpart.

Step 4: Equivalence training IV (Color photograph-to-colored line drawing). S once again was presented with a three-card array. This time, however, the array consisted of a colored line drawing of the object, along with colored line drawings of the two distractor objects. On each of the twenty training trials, S was taught to match the color photograph of the training object to its colored line drawing counterpart.

After the equivalence training sequence was completed, posttesting was conducted following the same procedures used during pretesting. The training and testing procedures were then repeated with the second training object pair and so on until the four-step sequence with all three object pairs (spoon/bowl, foot/shoe, crayon/drawing paper) was completed.

Condition 3: Repeated practice (Comparison Group).[48] This

[48]The third condition of the study was labeled a "comparison" rather than "control" group for a specific reason. Control groups typically are left untouched between pre and post measures. A comparison group technically is subject to manipulation; however, in this case the group was exposed to what might be called an extended baseline in which the subjects were given a series of additional test trials identical to those administered during pretesting.

comparison condition consisted of each S being administered 100 test trials which were interspersed with the training trials (see data sheet, Appendix D). The group thus was exposed to repeated practice with the same stimuli under the same conditions that were in effect during the pretest phase, except for the number of trials involved. Again, no feedback of any kind was provided, except on training trials. Test tasks again were administered in counterbalanced order across Ss and task stimuli.

Phase IV: Posttesting -- Visual Overselectivity Re-assessment

At the end of the intervention phase, each S was re-tested. Materials and testing procedures used during the pretest phase remained in effect during posttest sessions. Accordingly, S was returned to a training/testing sequence in which S had to (a) attain five of five consecutively correct match-to-sample trials on a CRF reinforcement schedule, (b) meet the five out of five correct matching criterion on a VR:3 reinforcement schedule, and (c) then be administered 36 (post)test trials interspersed with training trials, again conducted on a VR:3 schedule. The outcome measure that combined the posttest scores across the three tasks for each S was termed the POST (Posttest OverSelectivity Test) index.[49]

Training and Generalization Probes. As part of the posttest phase

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[49]The number of school weeks separating pretesting from posttesting ranged from two to six. However, there was no evidence that Ss who waited up to six weeks between pretest and posttest did more poorly on the three posttests than those who received posttesting relatively immediately. Moreover, no more than one day separated the final experimental session from the first posttest session.

of the study, two probes were conducted. The first probe focused on Ss who performed poorly on the posttest; the second was directed at those who showed the greatest gains on the posttest.

Probe 1: Stimulus acquisition. Ss in each of the two intervention groups who failed to improve on the posttest were trained to make the correct match-to-sample response on the task most frequently missed during posttesting. This instruction was provided to ensure that each S was capable of acquiring the discrimination which had proved most difficult (and perhaps most frustrating) during the testing phases of the study (cf. Lovaas et al., 1971). Therefore, if S failed to match the spoon component to the spoon/bowl compound during testing, for example, (s)he was trained during this probe session to make that match correctly on five consecutive trials.

Probe 2: Stimulus generalization. The three Ss in each of the two intervention groups who showed the greatest posttest gains were exposed to 10 trials of stimulus generalization probes, using the stimuli displayed in Appendix E. Specifically, each of the 6 Ss was first trained to match the letter/mailbox to its complement in an array. When the five-in-a-row on a VR:3 criterion was reached, S was exposed to 10 test trials using the letter component and the mailbox component. The same procedures were then followed to test for stimulus generalization with the basketball/basketball-net compound. As during the other testing phases of the study, no feedback of any kind was provided during these test probes.

Chapter 4

RESULTS

This research project was designed to answer the following two questions:

1. Which of two instructional intervention packages -- equivalence training or functional object-use -- results in a greater reduction in the degree of visual overselectivity?

2. Would either of the two packages prove more effective in reducing overselectivity than a comparison approach which involved repeated practice with pretest/posttest test materials?

As a preliminary step, the three groups were compared on a number of control variables. Results showed that the three groups did not differ significantly on CA (χ^2 = 1.53, df = 2, n.s.), on IQ (χ^2 = .13, df = 2, n.s.), nor on pretest scores (χ^2 = 1.75, df = 2, n.s.).

Table 6 presents the subject characteristics along with test results for all 21 experimental subjects. Table 7 shows the results of a crosstabulation of change scores (positive change vs negative change from pretest to posttest) by intervention group. A chi-square statistical analysis of the data was not possible, due to inadequate expected cell frequencies. However, examination of the various associations between the independent and dependent measures revealed the following: (1) More than 75% of the 21 Ss showed a decrease in degree of overselectivity from pretest to posttest. (2) 100% of Ss in the equivalence training condition were less overselective on the posttest.

Table 6

Subject Characteristics and Test Results

EQUIVALENCE Group

Code #	SEX	IQ	CA	PRETEST (COST Index)	POSTTEST (POST Index)	CHANGE
E1	M	20	13-2	21	01	+20
E2	M	47	7-6	38	20	+18
E3	F	20	6-11	30	12	+18
E4	M	24	10-0	21	09	+12
E5	M	87	4-5	21	13	+08
E6	M	24	11-11	35	30	+05
E7	F	43	13-2	18	13	+05
E8	M	84	3-7	29	27	+02
		$\bar{X}$=47.00	$\bar{X}$=8-7	$\bar{X}$=26.62	$\bar{X}$=15.62	$\bar{X}$=11.00
		SD=26.69	SD=3-7	SD=7.42	SD=9.56	SD=6.98

FUNCTIONAL OBJECT-USE Group

Code #	SEX	IQ	CA	PRETEST	POSTTEST	CHANGE
F1	M	47	7-7	27	05	+22
F2	M	46	15-9	47	34	+13
F3	M	22	10-3	13	03	+10
F4	M	35	5-10	20	17	+03
F5	M	33	16-3	34	39	-05
F6	M	80	3-7	30	38	-08
F7	M	*n/a	14-5	25	33	-08
F8	M	49	7-6	21	30	-09
		$\bar{X}$=44.57	$\bar{X}$=10-0	$\bar{X}$=27.12	$\bar{X}$=24.87	$\bar{X}$=2.25
		SD=18.33	SD=4-8	SD=10.30	SD=14.55	SD=11.68

Comparison Group

Code #	SEX	IQ	CA	PRETEST	POSTTEST	CHANGE
C1	M	39	10-5	47	34	+13
C2	F	22	14-5	27	18	+09
C3	F	73	13-1	25	20	+05
C4	M	37	8-5	34	32	+02
C5	M	42	3-0	31	32	-01
		$\bar{X}$=42.75	$\bar{X}$=11-6	$\bar{X}$=32.80	$\bar{X}$=27.20	$\bar{X}$=5.60
		SD=21.54	SD=2-8	SD=8.67	SD=7.56	SD=5.50

*n/a = not available

Table 7

Crosstabulation Table of Change Scores by Group

# of Ss: Row % Col % Total %	Pre-to-Post Change: Neg (Did more poorly on posttest)	Pre-to-Post Change: Pos (Improved on the posttest)
Equivalence	0	8
	0.0	100.0
	0.0	50.0
	0.0	38.1
Functional Object-use	4	4
	50.0	50.0
	80.0	25.0
	19.0	19.0
Comparison condition	1	4
	20.0	80.0
	20.0	25.0
	4.8	19.0

(3) 80% of those who did more poorly on the posttest relative to the pretest were in the functional object-use condition. (4) 80% of Ss in the repeated practice comparison condition improved from pretest to posttest. Based on this information, then, the equivalence condition appears to be a relatively effective approach to reducing visual overselectivity.[50]

Analysis of individual subject data provides added support for the initial finding that equivalence training was effective relative to the other two conditions as an instructional approach to reducing overselectivity. Figure 1, for example, presents performance scores of subjects in terms of an overall pretest-posttest change index. The graph is derived by subtracting the across-task posttest score from the across-task pretest score for each subject.[51] Improvement or decline in performance from pretest to posttest is indicated by the extent to which an individual bar graph extends above or below the abcissa. The more a bar extends above the abcissa, for example, the greater was the individual's reduction in overselectivity on the posttest measure relative to the pretest.[52] Similarly, a bar descending below the abcissa indicates that the individual proved to be more overselective after the intervention than before.

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[50]The Kruskal-Wallis nonparametric one-way analysis of variance of ranks was used to test for significant statistical differences among the three conditions. Statistical significance was obtained at the .16 level.

[51]See Appendix H for a logical task analysis of computations involved.

[52]The +13 index for C1 represents a decrease in the change index and thus a decrease in level of overselectivity.

Supoorting the findings from the crosstab cell entries above, Figure 1 suggests that the equivalence training condition was more effective than either the repeated practice or functional object-use condition in reducing visual overselectivity. Moreover, Figure 1 shows that in half the cases, functional object-use training clearly was not effective in reducing the level of overselectivity. (The repeated practice comparison group fell about midway between the two experimental groups.) Finally, from Figure 1 it is also clear that neither IQ nor CA was related to change score: generally, Ss with a higher IQ and/or CA did no better (or worse) than those with a lower IQ or CA.

> As an example of the procedures used to calculate the overselectivity index, consider the case of C1 (S #1, comparison condition). Suppose C1 earned the following pretest component scores on the three test tasks: 1/18, 13/18 (spoon/bowl), 11/18, 5/18 (foot/shoe), 15/18, 18/18 (crayon/drawing paper). The compound score for the pretest performance profile of C1 would be 21 (viz., 13-1 + 11-5 + 18-15). If C1 subsequently attained a posttest compound score of, say, 8 (using the same arithmetic computations), +13 would be the overselectivity index.

Figure 1 displays subject data in terms of a summary index of individual pretest-to-posttest change scores. Figure 2 presents the overselectivity data in terms of individual pretest and posttest scores and also in terms of averaged stimulus components calculated across the three tasks. Since all three test compounds were included in the original determination of the COST index (the summary pretest screening measure), all three stimulus compounds likewise can be combined in a way to permit examination of the extent to which their components contributed to the overselectivity of an individual subject.

Hence, component 'A' scores were averaged across tasks ([spoon + foot + crayon]/3). Likewise, component 'B' scores were averaged across

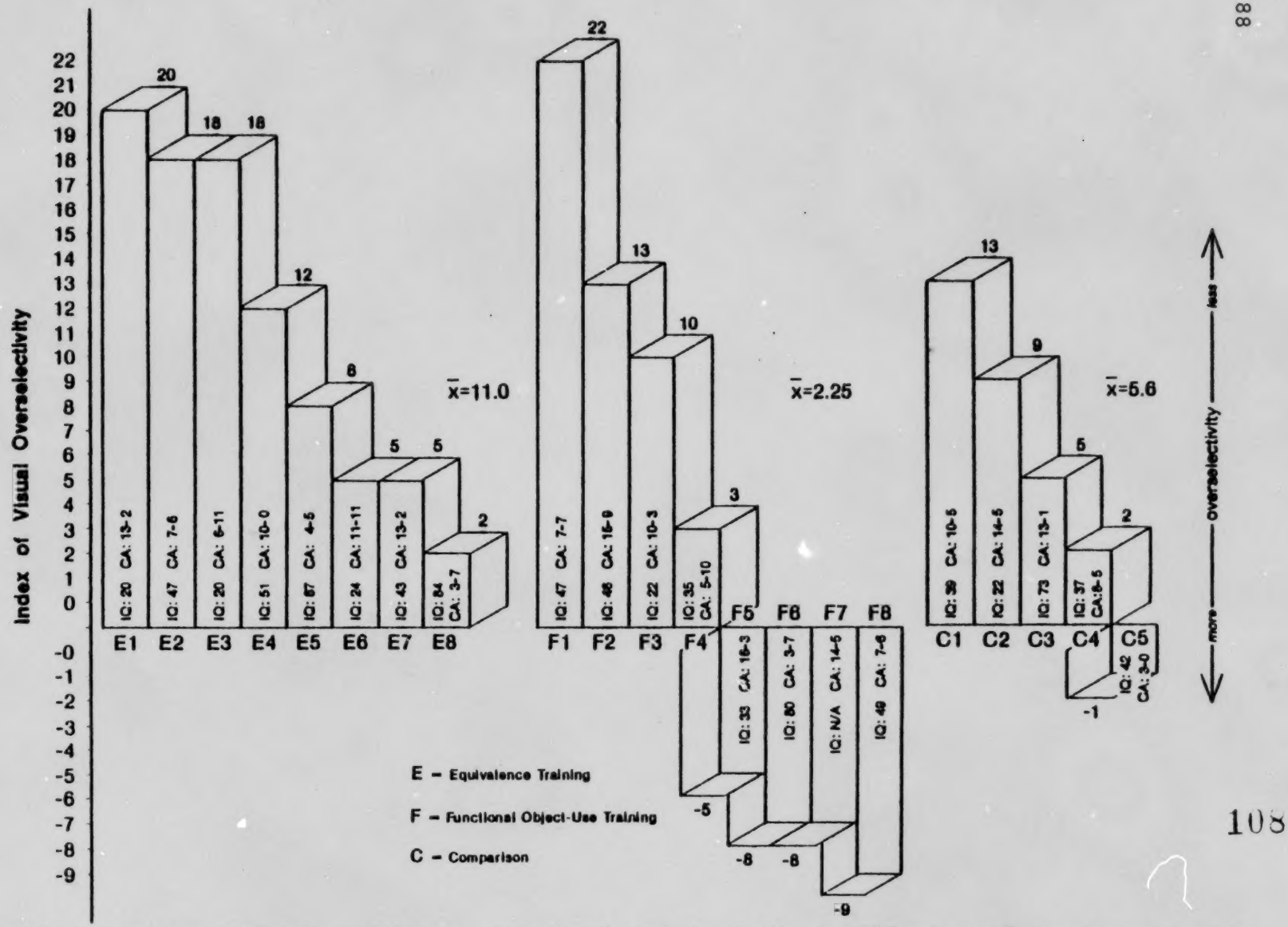

Figure 1: Summary overselectivity pretest/posttest individual subject performance measures

the three tasks ([bowl + shoe + drawing paper]/3). As a result, across-task component 'A' pretest scores thus can be compared to across-task pretest scores computed for the component 'B' components. Moreover, each of the pretest scores also can be compared to the across-task posttest scores, both within subject and across subjects and conditions. Figure 2 thus permits a visual analysis of degree of overselectivity by contrasting the two components ('A' vs 'B') of cue complexes averaged across the three tasks.

As Figure 2 shows, in only two cases (E5, E7) did subjects in the equivalence training condition fail to improve--to increase the number of correct matches-to-sample--from pretest to posttest, again in terms of averaged (across-task) component ('A' vs 'B') stimulus sets. Specifically, subject E5 did slightly more poorly on the posttest than on the pretest in terms of average component 'A' scores. Technically, equivalence training did not help E5, on average, to make more correct matches on the posttest, in terms of the three component 'A' stimuli presented. The intervention, however, apparently was helpful in terms of the component 'B' stimuli, given the pre-post improvement shown in Figure 2 for E5. Turning to the other case, E7 improved slightly from pretest to posttest on the averaged component 'A' set, though there was no improvement on the component 'B' complex for E7.

The first three subjects displayed in Figure 2 for the functional object-use condition improved from pretest to posttest on both component sets and thus overall. The rest of the cases, however, show negative performance change from pretest to posttest for that particular condition. Similarly, the comparison group which was exposed to

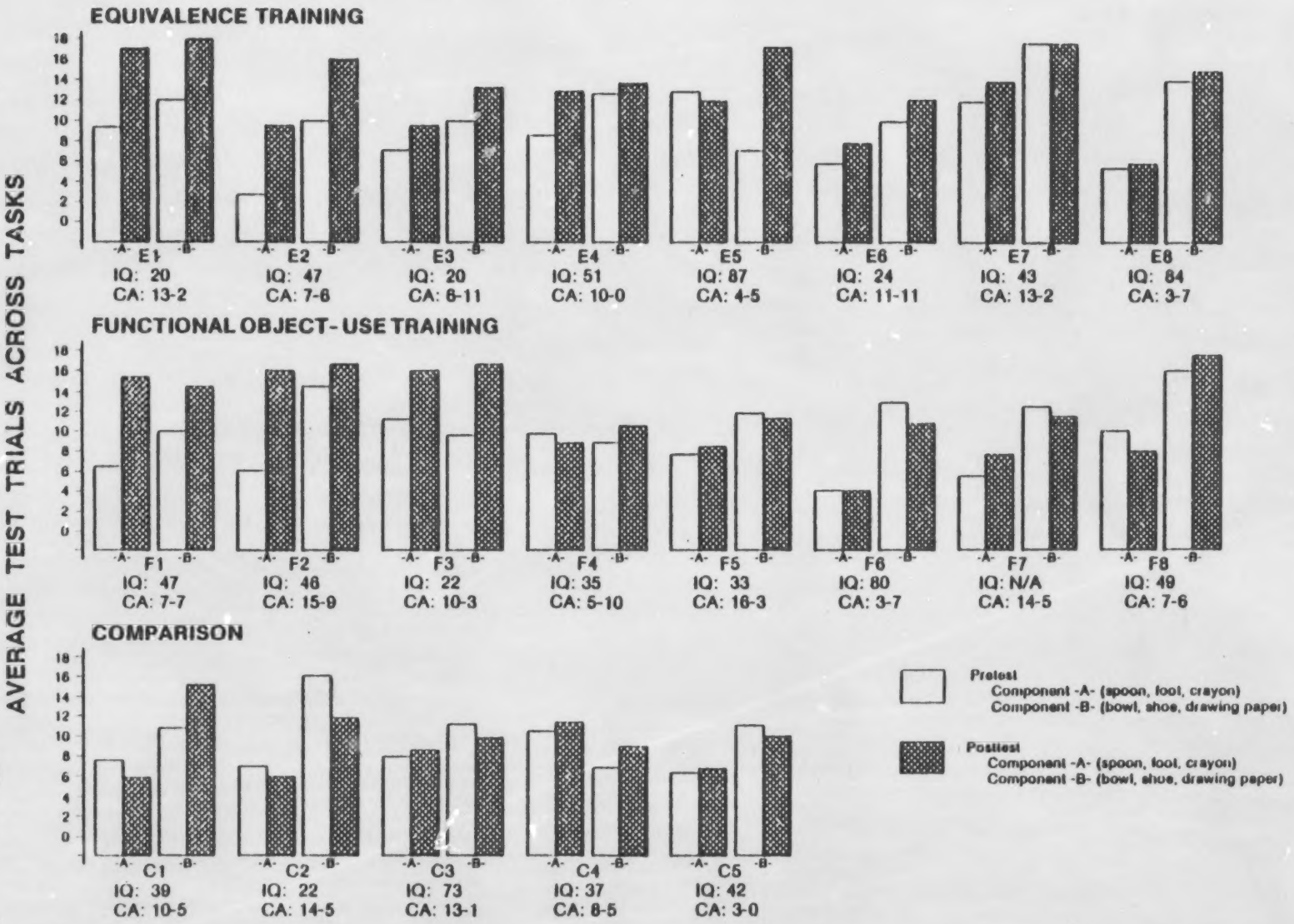
EQUIVALENCE TRAINING
AVERAGE TEST TRIALS ACROSS TASKS
E1 IQ: 20 CA: 13-2
E2 IQ: 47 CA: 7-6
E3 IQ: 20 CA: 6-11
E4 IQ: 51 CA: 10-0
E5 IQ: 87 CA: 4-5
E6 IQ: 24 CA: 11-11
E7 IQ: 43 CA: 13-2
E8 IQ: 84 CA: 3-7
FUNCTIONAL OBJECT-USE TRAINING
F1 IQ: 47 CA: 7-7
F2 IQ: 46 CA: 15-9
F3 IQ: 22 CA: 10-3
F4 IQ: 35 CA: 5-10
F5 IQ: 33 CA: 16-3
F6 IQ: 80 CA: 3-7
F7 IQ: N/A CA: 14-5
F8 IQ: 49 CA: 7-6
COMPARISON
C1 IQ: 39 CA: 10-5
C2 IQ: 22 CA: 14-5
C3 IQ: 73 CA: 13-1
C4 IQ: 37 CA: 8-5
C5 IQ: 42 CA: 3-0
Pretest
Component -A- (spoon, foot, crayon)
Component -B- (bowl, shoe, drawing paper)
Posttest
Component -A- (spoon, foot, crayon)
Component -B- (bowl, shoe, drawing paper)

Figure 2: Individual pretest/posttest performance measures averaged across tasks

unreinforced repeated practice with the test materials showed gains in only two of the cases (C1, C4) and one of those cases (C4) shows modest gains at best.

It should be emphasized that Figures 1 and 2 do not display comparable data; the Figures differ in important ways in order to provide different sets of information. Figure 1 simply transforms the raw change scores into a summary index of visual overselectivity by subtractiing POST from COST (see Table 6). Only pretest-posttest differences are shown. In contrast, Figure 2 goes beyond a summary measure of the results to look at visual overselectivity in more depth. Specifically, Figure 2 presents the results in three ways: 1) The stimulus compounds (e.g., spoon/bowl) are broken into component 'A' and component 'B' cues so that the separate components of the stimulus complex used to define visual overselectivity may be studied. 2) Scores obtained on the cues which comprise component 'A' are then collapsed across the three test tasks and averaged. Likewise, scores obtained on the component 'B' cue set (e.g., bowl, shoe, drawing) are averaged. The result is a descriptive measure of visual overselectivity which gives a mean performance score for each subject. 3) Finally, Figure 2 displays the 'A' and 'B' cue-set averages in terms of pretest and posttest results, thus also providing a visual observation of pretest-to-posttest changes for each subject. In sum, Figure 1 shows only raw individual summary change data, while Figure 2 addresses the pre-post changes from a stimulus control perspective--that is, from the position of trying to ascertain which stimuli exercise how much control over a given subject's visual attending behavior.

Taken together, the findings from the crosstab study of the various associations between variables combined with an examination of individual performance records, suggest that: (1) Equivalence training was effective as a strategy for reducing visual overselectivity; (2) the functional object-use intervention was generally ineffective; and (3) the effect of the repeated practice condition was about midway between the two experimental conditions.

Ancillary Findings

In order to identify potentially confounding variables associated with the study, further analysis of the individual-subject data were conducted and revealed the following: (1) No relationship between IQ or CA and posttest score or performance gain was detected. As Figures 1 and 2 show, individual performance was not related to either intelligence (IQ) or age (CA). (2) One of the three matching-to-sample tasks (viz., crayon/line drawing) was not color-controlled in order to investigate whether saliency (viz., color) influenced responding. The mean compound scores across all Ss for each of the three tasks were thus calculated. Results indicated that the mean compound score for the crayon/drawing paper task (X=16.76) fell about midway between the spoon/bowl (X=21.33) and foot/shoe (X=11.95), both of which were color-controlled. Had Ss been color-cued to the correct choice, the compound score would have been much lower (refer to page 77 above). (3) No "learning-to-learn" acquisition curve across trials was detected with any of the 21 Ss. That is, when the set of 18 test trials for each of the two components of each compound (e.g., spoon vs bowl) was separated into three blocks of 6 trials each, no increasing trend in correct responding in either the

emerged. (3) No position preference patterns were uncovered. (4) There was some evidence that Ss showed a stimulus preference bias. On the crayon/drawing paper task in particular, the main difference between the drawing paper stimulus (sample) and the writing paper stimulus (distractor) was the presence of straight, horizontal lines on the writing paper. During both pretest and posttest trials, where S was supposed to match the drawing paper to its test sample, Ss who made an incorrect match were four to six times more likely to select the writing paper distractor rather than the other distractor (pencil). This apparent stimulus preference pattern was discovered only with that one task—the task, incidentally, which had not been color-controlled. Overall, however, of the six distractors available during the three test tasks, plate was selected on a disproportionately large number of trials (68%) and fork on fewer trials (36%) than expected by chance. (5) All Ss who were able to acquire the pretraining matching-to-sample criterion response did so within 15 trials. Further, all Ss who succeeded in learning the criterion pretraining response maintained about a 99% level of correct matching-to-sample performance on the 72 training trials per task. (Data collection records showed that at most, an S incorrectly matched correct stimuli on 1 or 2 of the 216 (72 training trials X 3 tasks) total training trials available.) (6) All Ss acquired within 30 trials (range: 7-28) the discrimination most frequently missed on the posttest. (7) The two Ss in each condition who showed greatest improvement on posttest score and were thus immediately probed for stimulus generalization did no better than Ss who did more poorly on the posttest than on the pretest. For example, S labeled E1 attained component scores of 6/10, 8/10 on the letter/mailbox compound and 7/10,

8/10 on the basketball/ basketball-net compound. E2 scored 2/10, 5/10 on the letter/mailbox and 2/10, 10/10 on the basketball/basketball-net compound test. E7. however, who improved less than either E1 or E2 on the posttest, scored 7/10/, 10/10 on the letter/mailbox test and 10/10 on both components of the letter/mailbox test. There appeared to be no relationship between posttest score or pretest-posttest change and performance on the stimulus generalization probes. (8) Inter-rater reliability (mean percent agreement per phase) ranged between 96% and 100%. (9) All Ss acquired within 5 trials the conditional discrimination most frequently missed during testing. (10) No Ss were lost during the course of the study. (11) Finally, no evidence emerged to suggest that Ss at one site performed any better on the pretest or posttest than Ss at the second site.

Chapter 5

DISCUSSION

The main findings of the study may be summarized as follows. (1) Analysis of grouped and individual data showed that equivalence training was more effective in reducing overselectivity than either functional object-use or repeated practice. (2) No relationship was uncovered between IQ or CA and performance on either the pretest or posttest overselectivity measures. (3) No evidence emerged of a relationship between individual pretest or posttest performance and such control variables as stimulus saliency (color, shape, texture), trainer, test site, experimental setting, interval separating pretest and posttest measures, or interval between final intervention session and initial posttest session. The nature of the findings, however, raise a number of statistical, design, and interpretive ues worth discussing.

Statistical Issues

The lack of statistically significant differences was not surprising in light of the small sample sizes and complexity of intervention packages involved (Huck et al., 1979; Siegel, 1956). Again, more than 150 autistic candidates were screened for the study with the expectation that 15 subjects would be available for each of the three experimental conditions. Unfortunately, only 21 of the some 150 children met the dual overselectivity criteria, thus severely limiting

sample size and the power of the interventions to reflect a difference, statistically. Nonetheless, other procedural options were available at the outset which presumably would have increased the likelihood of statistical significance.

First, the subject samples could have been enlarged in either or both of two ways. For one, the diagnostic criteria used to identify autistic subjects could have been relaxed. Specifically, a less rigorous set of descriptors would have increased the subject sample. A larger sample presumably would have included additional autistic subjects with more advanced perceptual skills. Given the link between perceptual development and overselectivity (Gersten, 1980; Newsom & Rincover, 1981; Wing, 1976), a larger pool of such skills might have resulted in greater posttest gains. If so, then those increased gains may well have translated into more statistically significant findings, depending upon the research methodology and analytical techniques employed.

Alternatively, the size of the total subject pool could have been nearly doubled had different screening criteria been adopted for establishing the presence of overselectivity. In previous studies (e.g., Koegel & Wilhelm, 1973; Litrownik et al., 1978; Schover & Newsom, 1976), a criterion of 75% correct matches to one of the component stimuli of a compound was used as the measure of overselectivity. The present study, however, altered that criterion in two important ways. To begin with, the pretest procedure required that measures be taken directly on both components of the cue complex (viz., at least 50% on one, minimum of 33% difference between both). That criterion then had to be satisfied on at least two of the three pretest tasks in order for a child to be included

in the study. Had both these criteria been slackened, the subject sample pool would have grown from 21 to between 31 and 40, again perhaps leading to statistical significance on the outcome measure.

In addition to increasing sample size by modifying the parameters for defining autism or overselectivity, the statistical significance of the findings might also have been influenced by increasing the number of intervention trials. Several investigations (e.g., Koegel & Wilhelm, 1973; Schover & Newsom, 1976) reported that 50 to 100 trials were needed just to train criterion baseline behavior before assessment of the handicap could be initiated. The present data showed that all but three subjects learned the baseline matching behavior well within 300 trials, and in fact acquired the behavior in 15 trials or less. However, due to the exigencies of the research setting (teacher schedules, available release time for subjects, etc.), only a relatively few (100) training trials were available for acquiring task(s) associated with each of the three conditions. In truth, it may be that the study was too brief. Had, say, subjects been exposed to 300 training trials or more, there is some evidence to suggest that the added practice might have produced overlearning which, in turn, presumably would have been reflected in improved posttest performance scores (Koegel et al., 1980; Rincover, 1978; Schover & Newsom, 1976).

Finally, of course, the significance level adopted for statistical purposes ($p < .05$) could have been changed before initiating the research. The issue is not as trivial as convention might suggest. Research decisions invoked in setting significance levels have to do with statistical risk—namely, the risk to those affected most directly

(viz., pupils and teachers) if an intervention fails. With a significance level pre-set at .05, the intervention could be expected to fail—by chance alone—only one time in twenty. Parenthetically, were chemotherapy the intervention of choice, a .05 risk of failure probably would be unacceptable. Drug treatments adhere to far more stringent (p = .001, for example) standards (or so one would expect, given the dire consequences of an overdose). In education, on the other hand, with an instructional treatment that is parsimonious (easy to use) and risk free (no resultant physical harm to the pupil if the plan fails), a significance level of even .20 might not be unwarranted. From the standpoint of hardpressed practitioners looking for solutions to fundamental classroom problems (viz., overselective learning handicaps), a remediation effort effective 80% of the time (given p = .20) seemingly would be welcomed. In summary, it is easy (perhaps obligatory) to emphasize the relevance of statistical significance testing to "sound research." Clearly, as Cronbach and Snow (1977) are quick to acknowledge, there is an "...exaggerated emphasis on testing of a *a priori* hypotheses; everyone is a captive of the Zeitgeist" (p. 16).[53] They go on to say that "practically important effects at the group level are most unlikely to be established as statistically significant in any one study" (p. 514). Campbell (1969) supports that view by maintaining

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[53]The use of statistical tests and appropriate significance levels and sample sizes is seldom unequivocal. Professional judgment may perhaps be a "main effect" of such determinations. For a short review of discretionary judgments involved in the process of statistical decision making, the reader is referred to Henkel, 1976; Hersen and Barlow, 1976; Huck et al., 1979; Kerlinger, 1979; Marascuilo and McSweeney. 1978; Nunally, 1978; Siegel, 1956; and Thorndike and Hagen, 1977.

that "statistical tests are relevant to at best one out of fifteen or so threats to validity" (p. 410). It is this problem of excessive deference to and reliance upon significance testing which may be called "statistical hegemony." Such zeal is unfortunate, for more important than the issue of statistical analysis is the broader concern with experimental design itself and the nettlesome gremlins which can invade and confound a study. Consequently, the yellow flag raised by Cronbach and Snow (1977) on this issue bears repeating: "In instructional research, hypothesis-testing (may) turn us toward sterility" (p. 519).

Design Issues

To avoid the pitfalls of "research sterility" which might be brought about through statistical hegemony requires that issues other than those attendant to statistics be emphasized. Specifically, there are a number of design and interpretive concerns which bring to light other dimensions of data analysis which deserve brief mention.

Data analysis, to begin with, is more than simply a brief search for statistical significance. It is an exploration, a collection of alternative ways of looking at research results. Whatever the perspective, however, a desideratum of serious research is the ability to demonstrate empirically that the independent variable (intervention) accounts fully and solely for all changes in subject performance. Equally certain, of course, is the fact that research by definition is imperfect, impure—forever beset by what Webb et al. (1966) call "plausible rival hypotheses" (p. 8). The question thus becomes one of ascertaining whether or not any of a host of possible research artifacts

(viz., subject, measurement, trainer, setting) may be construed as "internal threats" to the validity of a study (Campbell & Stanley, 1963). Do "demon" artifacts so confound or threaten research results as to compete with the independent measure in explaining the data? (Too often, it seems, the answer is in the affirmative.) The extent to which potential threats do indeed confound a study determines the degree to which the study has been experimentally "controlled" and further, whether legitimate "strong inferences" (Platt, 1964) about the data may be drawn. That such a caveat pervades all research points to the need for careful attention in selecting designs and tactics to control for such shortcomings.

The present study thus attempted to minimize the existence (or at least the impact) of numerous experimental confounds that otherwise might give rise to rival explanations of the data. While they appear to be low-grade threats, several possible confounds warrant attention if research on overselectivity is to make headway in providing believable solutions to the handicap.

The first threat deals with selection of appropriate research design. To be sure, the design (pretest-posttest control group) and sampling technique (criterion-based selection, random assignment) were chosen with the expectation of making substantive judgments about the nature of visual overselectivity and the three approaches to remediating it. However, by the time the operational definitions and subject selection parameters were set and screening was begun, it was not possible to then alter the research design. As an afterthought and in light of the existing sample size, a more appropriate framework probably

would have been a small group across-subject multiple baseline design.[54] Unfortunately, sufficient time was not available to restructure the study in order to incorporate that particular alternative.

In addition to selection of appropriate experimental design, the complex relationship of numerous stimulus variables and training factors to the dependent measure (overselectivity) likewise posited potential confounds to the independent measure. Briefly, recent research has found that overselectivity findings may be less a result of the independent variable and more an artifact of such factors as reinforcement (Koegel & Egel, 1979), reinforcement schedule (Egel, 1980; Koegel et al., 1979), language cues (Carr, 1978; Dunlap & Koegel, 1980), instructional setting (Rincover et al., 1978), training method (Nelson et al., 1975; Walls et al., 1980), intertrial latency (Croll, 1970; Koegel et al., 1980), data analysis procedure (Linn, 1981; van der Linden, 1981), or even "mortality" (differential loss of subjects due to illness, change of address, or perhaps change of heart).[55] Against the weight of so many potential confounds, applied studies clearly should include fully explained experimental procedures so that subsequent research may repeat the methodology and hopefully obtain similar results, thereby strengthening the validity and generality of conclusions.

Perhaps of equal importance and also related to design artifacts

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[54] A discussion of single subject experimental designs exceeds the intent of this paper. However, for an excellent review and analysis of such designs, the reader is referred to Hersen and Barlow (1976).

[55] No subjects were lost during the course of the study.

are several additional experimental concerns. Cronbach and Snow (1977) argue persuasively, for example, that while treatment x aptitude interactions exist, the data are highly equivocal; thus, the substantive problem confronting research-on-teaching remains: "Which characteristics of the person interact dependably with which features of instructional methods" (p. 493)?

One such "characteristic" in the present study was sensory modality. Typically, clinical studies have investigated overselectivity within the visual (and to some extent, auditory) modality, while bypassing taste, smell, and touch. In terms of remediation, efforts again have been restricted largely to the visual modality. This tradition, as it were, may reflect the belief that what is discovered to "work" in remediating overselectivity in one modality might generalize to a second or third modality. (It also could be that it is less difficult to assess and remediate the handicap within the visual modality!) In any case, researchers interested in studying overselectivity should bear in mind that, quite logically, instructional strategies which succeed "visually" may be quite ineffective in any one or more of the other sensory modalities. Looking at the present study, equivalence training appears rather promising as an instructional strategy for modifying visual overselectivity (see discussion below). It might not prove as effective, however, if the lock-step, stimulus-shift tactics associated with equivalence training were applied to overselectivity handicaps in the auditory modality. (Such programming is quite feasible, by the way.) However speculative at this point, further research may reveal the need for remediation strategies which are

modality-specific, even at the risk of adding yet another dimension to the aptitude-treatment controversy (Cronbach & Snow, 1977).

Moving to the other side of the instructional equation to which Cronbach and Snow (1977) refer, two "features of instructional methods" come to mind regarding visual overselectivity—namely, mode of intervention and previous experience with the task materials (e.g., spoons, bowls, sand, crayons, paper). Turning first to mode of intervention, it may be that for some subjects, the relatively complex matching-to-sample paradigm might prove ineffective as a training strategy compared to, say, the comparatively simple two-choice simultaneous discrimination mode (Bryson, 1970; Cumming & Berryman, 1975; Trabasso & Bower, 1968). If so, then the main effect of a treatment with some subjects might be the mode used to present the intervention rather than the intervention itself. In regard to task materials, on the other hand, there is evidence (e.g., Brown, 1969; Dunlap & Koegel, 1980; Gibson, 1969; Ross, 1977) to suggest that stimulus materials can themselves interact with the dependent measure. Subjects familiar with materials used during testing may react quite differently (perhaps better on pre/post measures, perhaps worse) than participants for whom the stimuli (spoon, bowl, etc.) are novel, again diluting the effect of a treatment. On both points, of course, systematic outcome data are needed to evaluate the strength of the argument.

Associated with task materials as a possible confound is the number of stimulus cues embedded in a task and the effect that variable alone might have on measures of visual overselectivity. Performance patterns

of subjects may differ remarkably, depending upon whether the autistic child must discriminate between, say, two cues (i.e., spoon vs. bowl) or among several cues of a task complex. All else being equal, the greater the number of cues, the greater the difficulty in making the correct discrimination (Eimas, 1964; Houston, 1967).

Lovaas et al. (1979) have reviewed the literature on this point and conclude that, with autistics at least, there is some evidence to support a positive relationship between overselectivity and number of cues comprising a stimulus complex. Hence, the multiplicity of stimulus cues (smell, weight, size, color, texture) which typically infuse such object perception activities as three-dimensional discrimination tasks could adversely affect the ability of the overselective child to transfer selective attention from those objects to their abstractions (photographs, line drawings) which presumably contain considerably fewer (prompting?) cues. In this light, practitioners probably should design attention, discrimination, and matching activities so that the transfer of selective attention from objects to their representations is facilitated. The equivalence training program set forth in the present study attempted to provide a prototype of one such stimulus shaping approach.

A different type of threat to the validity of the experimental variable concerns a "learning to learn" or "practice effect." Cronbach and Snow (1977, Chapter 5) maintain that performance improvement as a function of practice is quite common in experimental studies with children: "A treatment serves best those students who have already

learned how to take advantage of that kind of treatment" (p. 506).[56] This potential confound, it will be recalled, was evaluated at the conclusion of the study. (The 18 test trials per stimulus were divided into three groups and the data then graphed to determine if test performance improved across trials. It did not.) With the comparison group in the study, on the other hand, the effect of practice (with pretest materials) was investigated systematically. Results added weight to earlier findings that repeated practice may indeed be a viable strategy for overcoming (visual) overselectivity. In short, this particular confound, like several others, was empirically accounted for within the framework of the methodology, thus eliminating it as a potential competing hypothesis to the independent variable.

On another point relevant to potential design confounds, several researchers (e.g., Frankel et al., 1978; Koegel & Wilhelm, 1976; Lovaas & Schreibman, 1971; Reynolds et al., 1974) have reported that some autistic subjects exhibited little or no overselectivity when tested and others who were overselective failed to improve as a function of intervention. It may be discovered in time that this inconsistency in overselectivity may be due to an interaction effect between the intervention itself and level or degree of overselectivity. If so, then for children found to exhibit "mild" overselectivity (perhaps a 60%-40% differential in matching correctly the cues of a two-component cue complex on one task), an appropriate treatment may be repeated practice with the task materials alone. Alternatively, a parsimonious strategy

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[56] Or as the authors state at another point: "The residue of experience is a heightened ability to make use of more such experience" (p. 506).

for pupils found to have "moderate" overselectivity (75%-25% split, one task) may be a program similar to the functional object-use prototype tested in the present study. Finally, children assessed as having "severe" overselectivity (perhaps a minimum 50%-33% split on two of three test tasks) may have to be placed in a more lock-stepped program involving behavioral teaching methods, fine-grain task analyses of target skills, longitudinal training formats, and continuous performance monitoring—of the sort represented by the equivalence training package just described (cf. Sidman & Stoddard, 1966; Zeaman & House, 1979). Such a rigorous programmatic thrust might indeed facilitate the task of capturing, directing, and shifting attention within-dimension (to the critical attributes of objects) and across-dimensions (from objects to other symbol systems—e.g., photographs, line drawings, etc.) for severe overselectors. Larger sample replications of the present research might be a first step in shedding more light on the possibility of this sort of interaction.

One final potential design-related confound exists which could lessen the validity of applied research in general and the present study in particular. It may be described as a "search-research interaction."[57] The problem arises amid the impact of two realities confronting contemporary applied research: first, the impact of client protection procedures (e.g., informed consent, right of refusal, least harm doctrine) on the "seek and recruit" process of locating subject samples;

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[57]The hypothesis may be considered as a corollary to "selection bias," to "test-retest sensitivity," or to "subject reactivity," depending upon personal perspective and interpretation.

second, the resultant problem of finding adequate numbers of research subjects to work with. In truth, it would not be surprising to discover that major research centers find themselves forced to use and re-use many of the same subjects in research projects. Where such is the case, differential treatment effects due to degree of research experience might contaminate the validity of the study. Clearly, subjects who participate in numerous research projects (perhaps due to blanket release clauses) have a greater likelihood of "doing well" than subjects exposed to a laboratory experiment for the first time. Logically, then, research-naive subjects are likely to differ on pre and post measures than subjects "accustomed" to research milieux. To date, few if any published studies have reported selection or assignment measures designed to control for this particular threat. Given that the present study similarly ignored the problem, this search-research interaction alone may have been the influential factor, wholly apart from the treatment itself.

Interpretive Issues

Aside from issues of statistics and design-related gremlins are matters of pragmatic interpretation of research data. True as it is that data analysis is a collection of exploratory processes, even more basically data analysis is an attitude. It is respectful skepticism and a persistent sense of inquiry. In a recent work noteworthy for summarizing this research ethic, Hartwig and Dearing (1979) argued persuasively that statistics too often masks alternative paths to (and patterns in) research data. Data analysis, for them, begins with a

visual observation of trends. As they put it, "visual analysis should precede statistical analysis even when the latter is the desired end product" (p. 10). The authors then suggest that a first step in this process of "observational data analysis" involves the use of graphs: "Graphical representation of data opens up unanticipated patterns in the data since they can be the most revealing outcomes of the analysis" (p. 9).

The graphs used to summarize the data from the present study underscore this point. Observationally, the equivalence training group was superior to either of the other groups. Similarly, the repeated practice group clearly was better than the functional object-use group. Moreover, the data supporting such conclusions were visually apparent in the second graph which showed pre-post gains/losses for all subjects across the three conditions. Yet, undue emphasis upon statistical outcomes can so restrict analysis that important visual information (as in the present study) may be masked. Perhaps for that reason Cronbach and Snow (1977) conclude, "inferential statistics qualify the interpretation of descriptive statistics: this makes them important, but subordinate" (p. 516).

Upon what basis, then, may the worth of an applied research study be measured? How can a careful analysis of statistical, design, and "noise" variables be forged into a useful criterion for making "go/no-go," accept/reject decisions regarding innovative programs? A beginning answer would focus on believability of data or, more accurately, on degree of believability. The more believable the demonstration of worth, the greater the expected benefit and, by

extension, the greater the likelihood of acceptance and eventual adoption.

For scientists, questions of worth tend to address (in theory, at least) strategies and procedures of direct (same experiment again) and systematic (same experiment, one factor varied) replication (Sidman, 1960). If a study provides adequate methodological precision to enable its procedures to be tested and re-tested in future studies, then consistent results will enhance its worth. Surely, the greater the risk (or concern) that the sort of potential confounds enumerated above may undermine the validity of a study, the more the need for replication--for others to repeat the research. As an example, one phase of the present study attempted to systematically replicate earlier work concerning the effect of repeated practice on visual overselectivity. Results of that effort did in fact support prior findings, thus adding further to the believability (and perhaps ultimately, acceptability) of practice alone as an effective approach to reducing overselectivity.

Dewey (1916) has counseled that "the educator's part in the enterprise of education is to furnish the environment which stimulates responses and directs the learner's course" (p. 180). Properly, then, teachers also can be expected to have keen interest in notions of worth, believability, and acceptance. They too must make program adoption decisions, given not only their Deweyan mission but also the press of accountability and increased threats of educational malpractice as well.

Yet, while the issue remains one of worth, the focus for teacher is more akin to parsimony: That is, will the study live up to its billing? Will its claims solve a classroom problem for the teacher, and in such a

way that little departure from standard operating procedures will be required? Can greater positive change in pupil performance obtain from the innovative, research-based program? Within the parameters of the present study, the classroom teacher needs to be convinced that an equivalence training strategy which uses objects (and their pictures) readily found in the classroom will indeed reduce the level of visual overselectivity in at least some such overselective pupils. If the program (or even the repeated practice strategy) proves effective, the teacher may make a pragmatic decision to give it a try (Etzel & LeBlanc, 1979; Kazdin, 1979).

Unfortunately (if not surprisingly), experience finds that interpretations of worth and importance do not ensure adoption of innovative instructional programs. There are many reasons for resistance, not the least of which concerns data-free administrative decrees. As Boren (1972) warns, too often the prevailing administrative policy-making process amounts to little more than: "When in charge, ponder. When in trouble, delegate. When in doubt, mumble" (p. 39). The irony is that while the classroom teacher is expected to be effective in the classroom, (s)he seems powerless to translate decisions about instructional program adoption into policy or practice. Perhaps it is this lack of objectivity in decision-making that led Machiavelli (1935) to conclude long ago that, "there is nothing more difficult to carry out, nor more doubtful of success, nor more dangerous to handle, than to initiate a new order of things" (p. 49).

At any rate, it is the seeming impotency of practitioners to function as innovators that leads to a question Stolz (1981) raised

recently: "Does anybody care?" Addressing the problem confronting the process of program adoption generally, Stolz (1981) concluded that "outcome data alone is (sic) not sufficient to ensure adoption by policymakers" (p. 493). As she analyzed the dilemma, program adoption decisions often are bolted onto more upper-level administrative concerns — concerns such as timing, whether the innovation matches the mission of the school, the power/influence of the prospective program user, and whether or not the program meets a pressing local management need, political or otherwise. While such variables do constitute effective implementation policy-making (see, for example, Berman & McLaughlin, 1976; Mann, 1977; McLaughlin, 1976; Pincus, 1974), the role of teachers in evaluating the worth of innovative programs seems illogically emasculated by what would appear to be hidden agendas decidedly non-instructional in nature. This curious lack of entitlement to greater policy-making roles suggests that while teachers may be 100% for progress, their superiors may be 100% against change. The charge to applied researchers within such a climate is to remain relentless in their efforts to refine, extend, and promote empirical investigations which are found to yield benefits applicable to classroom settings. Indeed, there seems no alternative if, as Bereiter (1972) argued, the goal of instruction is to "produce a certain kind of performance in the child" (p. 391).

Practical Implications

The primary objective of the present study was of course to compare the impact of two instructional interventions on the overselectivity of

autistic pupils. At the same time, however, the study had a number of secondary purposes which have resulted in several suggestions for future instructional practice.

One such purpose related to instruction. The importance of gathering accurate test data for use in evaluating severely handicapped children is now a priority issue (Cone, 1978; Haring, 1977; Jansma, 1980). In response to this challenge, the study focused on assessment procedures and training protocols which could be used by teachers both in screening for (visual) overselectivity and for working with the learning handicap once identified. With an eye toward IEPs, the four essential components of traditional lesson plans were set forth, including objectives, materials, procedures, and motivation strategies. Moreover, a high level of specificity was built into the testing and training procedures: behavioral objectives and logical task analyses were selected; instructional materials detailed; precise assessment parameters described; data collection, coding, and recording forms provided; model computations and concrete examples set forth; and pupil incentive systems proposed. In short, the study aimed to provide practitioners and applied researchers alike with a set of guidelines useful not only in research replication efforts but in programming effective delivery systems for training discrimination and matching activities as well.

Another interest of the study was the role and use of stimuli added on during instruction in order to facilitate learning. Typical, traditional teaching methods rely heavily on the use of prompts (special materials, voice fluctuations, physical gestures, teacher

demonstrations, peer modeling) as "starter cues" when training a new task. Yet several investigations over the years have found that prompt-intensive teaching methods, when used with autistic children, may be more harmful than helpful. Specifically, research has discovered that autistics have considerable difficulty shifting from prompts to the task itself (e.g., Rincover & Koegel, 1975; Schreibman, 1975). Such children tend to become "prompt junkies;" that is, they come to depend so greatly on helpful teacher cues that they later experience great difficulty shifting attention from the prompt to the actual task at hand (see Rincover & Koegel, 1975). Within the present study, the functional object-use condition made more use of prompts as extra instructional stimuli than did either of the other conditions. During the first several trials in each training session and during the introduction of a new task, it was necessary for the trainer to physically and then verbally assist subjects in the proper use of the instructional materials. The equivalence program, in contrast, did not require similar prompting since subjects already had acquired the necessary matching-to-sample behavior during pretraining trials. Generally, during equivalence training, a subject required one demonstration of the matching behavior, and that model was used to show where to place the object(s) on the table. The third--repeated practice--condition by definition avoided the use of prompts, since the task was simply to administer a series of unreinforced test trials interspersed with training trials, with only the testing trials being measured.

Within the functional object-manipulation condition, then, prompting may have interfered with a subject's ability to shift his/her

selective attention from objects to photographs used during training to the line drawings which appeared during testing. In light of previous findings concerning the use of prompts, the evidence continues to mount that practitioners should use traditional prompting procedures sparingly with autistic children and further, that when used, prompts must be systematically faded in order to avoid the possibility of "creating situations in which stimulus overselectivity is likely to occur" (Lovaas et al., 1979, p. 1242).

The present study also further substantiated the relative effectiveness of repeated practice as a remediation approach for visual overselectivity. This finding is important, if only because it is also the most parsimonious of the three procedures investigated. Repeated practice simply makes extended use of the testing-training-testing cycle and requires little modification of materials or change in instructional procedures. Of the several clinical (e.g., Koegel & Schreibman, 1977; Koegel et al., 1979; Schreibman et al., 1977) and two instructional (in the present study) remediation approaches available for reducing overselectivity, repeated practice may come the closest to meeting the criterion of instructional parsimony believed central to eventual program adoption.

Finally, the study screened nearly 150 autistic children in the search for visual overselectivity. That but 21 of 150 met the dual criteria for the handicap suggests that the incidence (new cases) and prevalence (old plus new cases) of visual overselectivity may be unexpectedly low. Where rigorous screening parameters are used, then, classroom personnel probably should not anticipate that younger autistic

pupils or even more retarded autistic children will necessarily or even probably exhibit (visual) overselectivity. The handicap appears rare, if tightly defined.

Future Research Considerations

Cronbach and Snow (1977), after reviewing the work on aptitude-treatment interaction, suggested that the goal of instructional research should be to "design enough treatments so that everyone will be able to succeed in one of them" (p. 9). The current state of instructional research in general is far from even remotely approaching this ideal, as indeed the review by Cronbach and Snow itself typifies. At the same time, significant advances in the understanding and treatment of overselectivity have been made in the past decade (see Dunlap et al., 1981). Yet, before the research community (or classroom teachers, for that matter) can expect acceptance and adoption of even these gains on the part of entrenched administrators, applied research in the area will probably have to improve immeasurably.

Accordingly, the present study points to a number of dimensions which future programs of applied overselectivity research can pursue: (1) The two instructional interventions have a strong theoretical base, an experimental history, and a practical relevance to the modern-day classroom. But, their effects need to be demonstrated on a larger and thus more believable scale. Accordingly, the study should be replicated systematically, perhaps comparing only the two interventions (omitting the repeated practice comparison group) and/or increasing the number of intervention training trials. Replication efforts might help to answer

concerns that the results in the present study were but a function of the setting (SCDC), the sample (autistic children from a small area on Long Island), training procedures (perhaps too lax), or any of a host of demon confounds previously discussed. (2) The study offers no support for earlier findings linking overselectivity to chronological age (cf. Day, 1980; Eimas, 1965; Schover & Newsom, 1976) or to level of measured intelligence (IQ). (cf. Lovaas et al., 1971; Wilhelm & Lovaas, 1976). Given the small sample sizes in the present study and the wide dispersion of the data (see Table 6), replication efforts should focus on locating experimental samples of at least 15 subjects per condition while at the same time striving to maintain rigor of definition (of autism and of overselectivity). Larger samples might produce more representative findings and thus shed more useful light on probable relationships that exist between visual overselectivity and IQ, CA, MA, and/or "developmental level." Larger samples might also counteract a major problem with nonparametic analyses: that is, robust intervention packages combined with meager subject samples can too easily mask important treatment differences, thus limiting generalizations that may be made about the population from which the samples were drawn. Larger samples mean larger conclusions, ceteris paribus. (3) The number of tasks should perhaps be increased from three to five or more, for two reasons in particular: a) to examine a possible link between visual overselectivity and task materials; testing and training on a combination of materials (some novel, some familiar) might affect indices of overselectivity; b) to pursue a finding of the present study that color-controlling the materials did not affect performance on the pre/post test measures; hence, color-controlling two tasks and

color-cuing the other three test tasks might provide interesting discrimination learning patterns. (4) An empirical test of stimulus generalization could be conducted, perhaps along the lines outlined in the present study. That is, subsequent to the pretraining - pretesting - intervention - posttesting sequence, subjects who improved on the posttest would be exposed to a series of test trials on new and different stimuli. This follow-up probe would monitor the extent to which newly developed fine-grain discrimination behavior spilled over to novel discrimination tasks. (5) Four issues could be investigated which arise immediately from the present research: (a) Was it possible that some subjects were "flooded" by the bombardment of stimuli inherent in the interventions, thus impairing their ability to attend to all relevant cues on a training or testing trial (see Lovaas et al., 1971; Lovaas & Schreibman, 1971)? (b) Was there a "near-receptor" sensory problem with some subjects, perhaps thereby prohibiting performance (see Hermelin, 1976; Hermelin & Frith, 1971; Hermelin & O'Connor, 1970)? (c) Did the fractionation or component testing procedure itself in some way adversely affect "breadth of attention" variables, again limiting performance of some subjects (see Zeaman & House, 1979, pp. 78-80)? (d) Did the study produce fallout in the form of unintended side effects which might affect future discrimination performance patterns of one or more of the experimental subjects? (Perhaps the increased one-to-one instruction, or structured manipulation of objects, or systematic reinforcing/extinction procedures would later lead to some sort of increased social play, improved attending behavior, or other collateral shift that should be monitored or manipulated empirically.) (6) Several plausible intervention-by-subject interactions discussed previously

could be studied, namely: overselectivity x modality, overselectivity x intervention; number of cues/task x intervention.

The study could be reinterpreted within the framework of Piagetian stage theory. The rationale for such a conception would be as follows: (a) Matching-to-sample activities may be considered as a training vehicle for developing classification skills (Lavatelli, 1973). (b) Classification skills are important to the development of object permanence (Robinson, 1976; Stephens, 1977). [Object permanence "(is) the ability to form mental representations or images of objects after loss of perceptual contact with them" (Wohlhueter & Sindberg, 1975, p. 513).] (c) The transition from objects to their symbols which both interventions in the present study require thus would involve the training and development of object-concepts. (d) Instructional activities therefore should focus on the pre-operational stage of cognitive development for, as Kahn (1979) states, the primary task of the pre-operational stage is the "mastery of symbolism...(the translation of) the action of the sensorimotor period into symbolic form" (p. 276).

During the functional-object use condition, for example, it might have made a difference from a Piagetian perspective to have included or substituted two phases in particular: (a) having Ss trace the objects after using them appropriately (perhaps in a darkened room in order to mask background distractions); or (b) having Ss engage in cooperative play with the objects, given the added haptic, visual, and auditory object-specific information such manipulation would provide.

Overselectivity also could be studied from an information

processing point of view, still within a cognitive development model. Memory typically is a major variable in discrimination learning, unless steps are taken to minimize its impact (as through simultaneous, conditional discrimination tasks). Accordingly, this study could investigate a variety of encoding and decoding processes, including rehearsal, storage, retrieval, and perhaps ways in which production or mediational deficiencies affect each (Flavell, 1975). Moving away from a strictly operant-based perspective on overselectivity to a more cognitive developmental interpretation of the handicap might, it would seem, go far to broaden our understanding of visual overselectivity and its impact on various learning processes.

Finally, future research endeavors might consider an even more ambitious consideration, and one which very well could have a dramatic positive impact on policy and decision makers resistant to adopting innovations. It is the application of micronics (micro-computer networks) to instructional design. Clearly, modernday education is now far more than just schooling and books. Rather, education is ecological, consisting of a complex configuration of formal and informal agencies (Cremin, 1976, 1977), ranging from the corner street gang to factory apprenticeships and (perhaps) to the "divine" insights visited upon youth by far eastern (and some near western) religions. Included within such a constellation of alternative educative styles is classroom-based computer technology.

In the face of political, fiscal, and monetary constraints facing public and private school education in the 1980s, innovative programs which are efficient, cost-saving in the long run, and effective in

improving school performance might eagerly be adopted by otherwise intransigent decision-makers. Shortly, micronics could prove to be the turnkey that opens the door to wider adoption of promising research outcomes. At least, such was one implication of a recent Sloan Foundation monograph (Koerner, 1981). "Since the world is now a technical system," the Foundation argued, "the educational experience should provide instruction in how (that system) works....To this end, students should...learn to use the computer and come to understand 'technology'" (p. 13). The major centerpiece of this "new liberal arts curriculum" would be a radically new commitment to what the Foundation called "technological literacy" (p. 9).

On a limited scale, the yield of this newfound technological literacy is already being enjoyed in education. There are, for example, several computer-based "data banks" (e.g., Source; CompuServe) presently available for sharing resources nationwide among professionals, including those in special education (e.g., SpecialNet, 1981). There now exist model systems which integrate instructional design with computer technology (e.g., Meyen, 1978; Romanczyk et al., 1980). Finally, efforts are underway to establish computerized "bibliobanks" for storing and retrieving user-generated information about materials, programs, and products available in special education (Hedbring, forthcoming).[58]

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[58]For a brief review of the progress (and controversy) which has accompanied the advent of computer technology in general and its growing influence on the process of schooling, the reader is referred to the following sources: Grimes, 1981b; Lautsch, 1981; Lecarme and Lewis, 1975; Lewis and Tagg, 1981; Milner, 1980; Milner and Wildberger, 1977; Murdick and Ross, 1975; Norris, 1977; Oettinger and Zapol, 1972; Peckham, 1976; Rosenberg and Sindelar, 1981; Seidel, 1980; Shane, 1982.

The introduction of micronics, then, if widely applied, could do much to upgrade and update the conditions of learning within special education classrooms (Hedbring & Holmes, 1977). Micronics could, for example, (a) free teachers from the tedium often associated with many of the iterative tasks involved in training low-functioning children (i.e., attention training, object identification, labeling, discrimination, classification, etc.); (b) expand and make more efficient the modes of instruction available to the teacher (e.g., matching-to-sample, discrimination, oddity training, video games, graphics, animation/simulations); (c) permit a greater degree of one-to-one instruction as teacher-assistants train "video-skills" (acquired through 'play and practice' instructional modes on the microcomputer display screen), leaving the teacher free to attend to other instructional concerns (motor training, social skills, language and speech activities, etc.). (d) dramatically increase the dissemination and thus availability of newly developed training tactics, instructional packages, and commercial materials.

Doubtless, in the not too distant future, assessment systems, behavioral objectives, logical task analyses, and model lesson plans will be available as guides for training attention, discrimination, matching-to-sample, self-help skills, and much of whatever else is found important to eventual least restrictive educational placement of handicapped individuals. Central office work stations, complete with desk-top personal computers, video screens, acoustic couplers, and a library of resource-rich diskettes, will be "hard-wired" to exploit the burgeoning technology of visual graphics, color-enhanced symbols,

animation, and other special effects, all within the framework of diagnostic/prescriptive instruction. The idea is no longer a dream. And future research efforts could make a timely and critical contribution by devising computer models, programs, and simulations for reducing overselectivity through the implementation of networks of microcomputer school-based work stations.

Conclusion

Dr. Samual Howe, an ardent and early advocate of the handicapped, stated emphatically in 1848 that "there is not one of any age who may not be made more of a man and less of a brute by patience and kindness directed by energy and skill" (p. 136), About a hundred years later, Bruner (1960) re-stated the ideal, perhaps a bit more eloquently: "Any subject," Bruner maintained, "can be taught effectively in some intellectually honest form to any child at any stage of development" (p. 31). While Bruner's dictum has undergone some revision in more recent times, it still remains the essence of diagnostic/prescriptive instruction.

Cronbach and Snow (1977) suggest that "(school personnel should) be concerned not with running a fair competition but with running a talent-development operation that will bring everyone somewhere near his or her highest level of contribution" (p. 8). But that task requires sound research, a readiness on the part of administrators to innovate, and a desire on the part of teachers to experiment. As the research on overselectivity illustrates, children may look but not see, may listen but not hear, may touch but not feel. The challenge thus facing

teachers, administrators, and researchers alike is enormous.

It was not long ago, as Goldberg and Lippman (1974) have noted, that the handicapped were hidden away in "mysterious, unknown places" (p.334). It was not long ago that the handicapped were summarily excluded from public classrooms. It was not long that the handicapped had to turn to the courts to save their right to an education. Now that the right is assured, now that the mandate is secure, present events suggest that their education remains yet to be ensured. Otherwise, the past decade of change on behalf of the handicapped will prove to be little more than a ten-year conversation.

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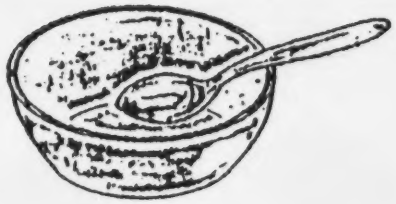
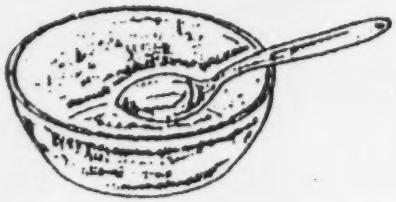
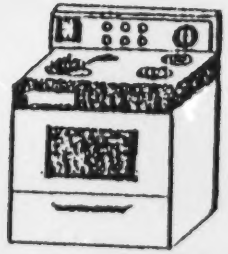
Appendix A

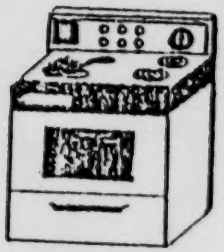
Illustration of the three sets of pretraining stimuli







Configuration of pretraining stimuli for spoon/bowl match-to-sample task



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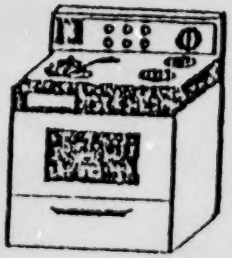
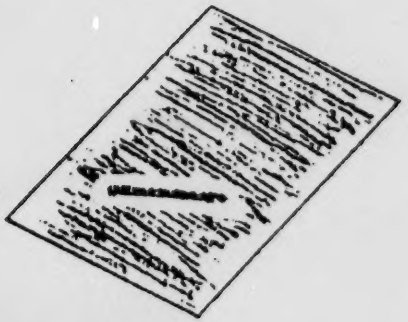
Configuration of pretraining stimuli for foot/shoe match-to-sample task

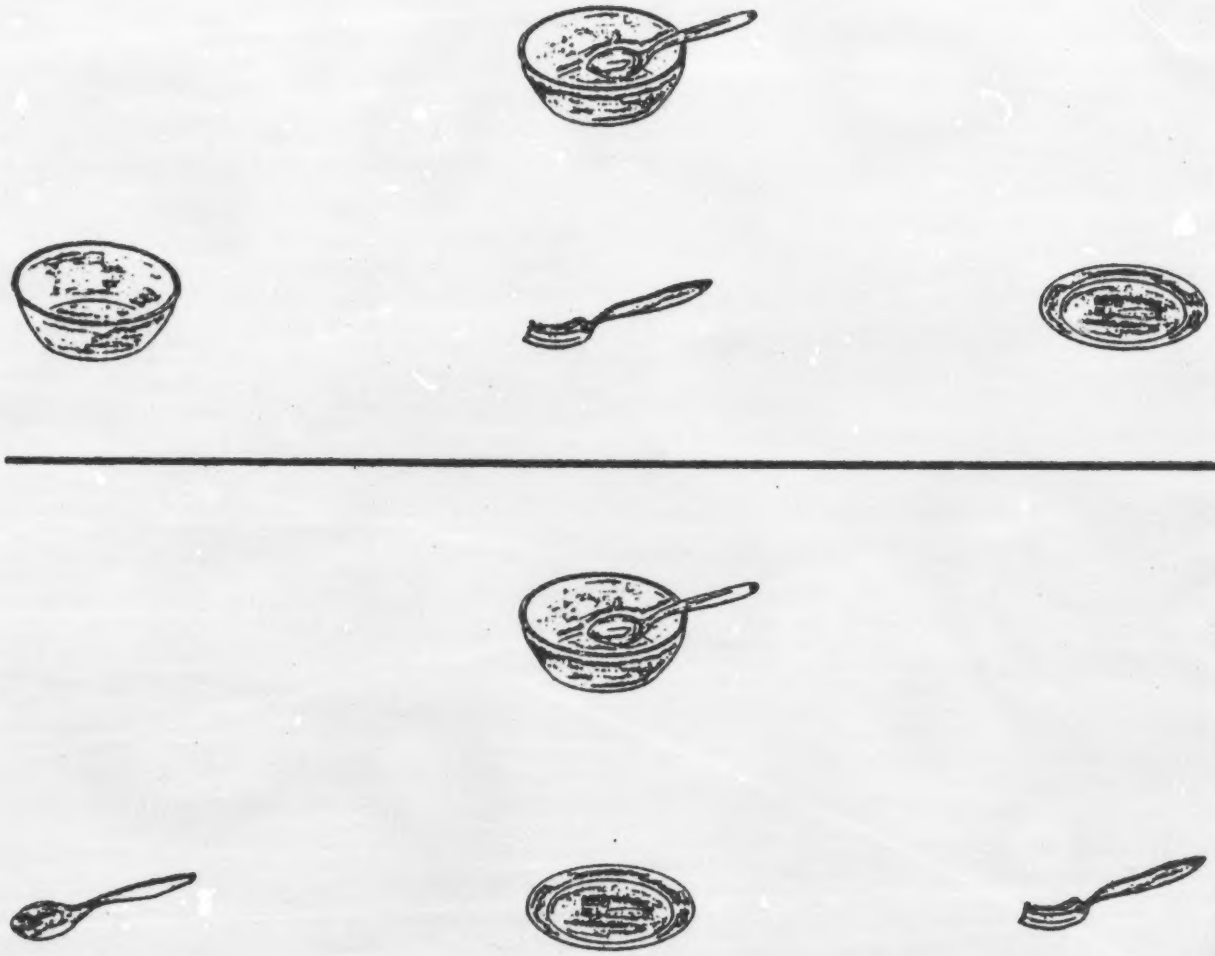




Configuration of pretraining stimuli for crayon/drawing paper match-to-sample task

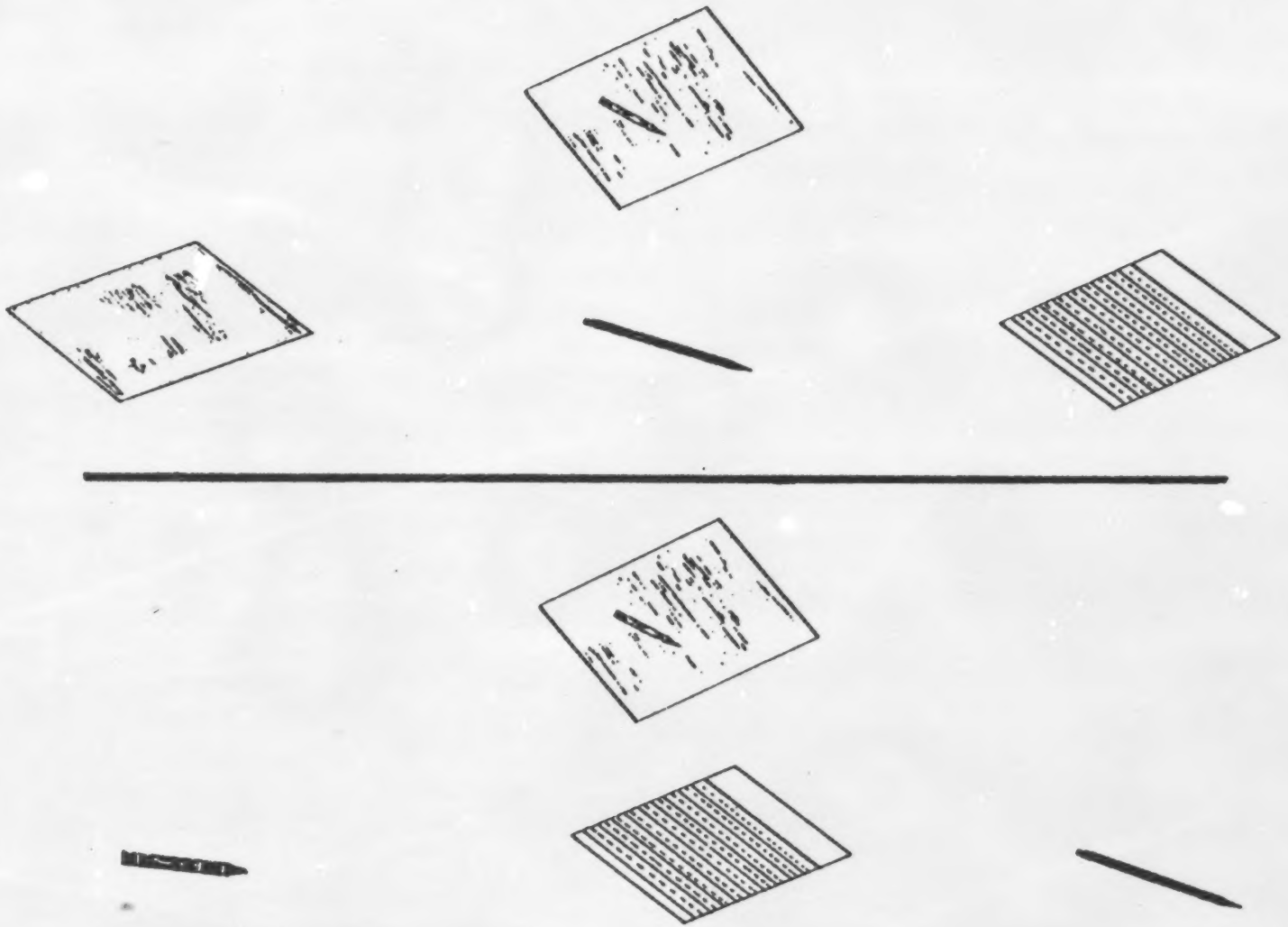
Appendix B

Configuration of the three sets of pretesting/ posttesting stimuli



Configuration of stimuli for spoon/bowl test trials:
50% of trials with "spoon-only" component, 50% with "bowl-only" component

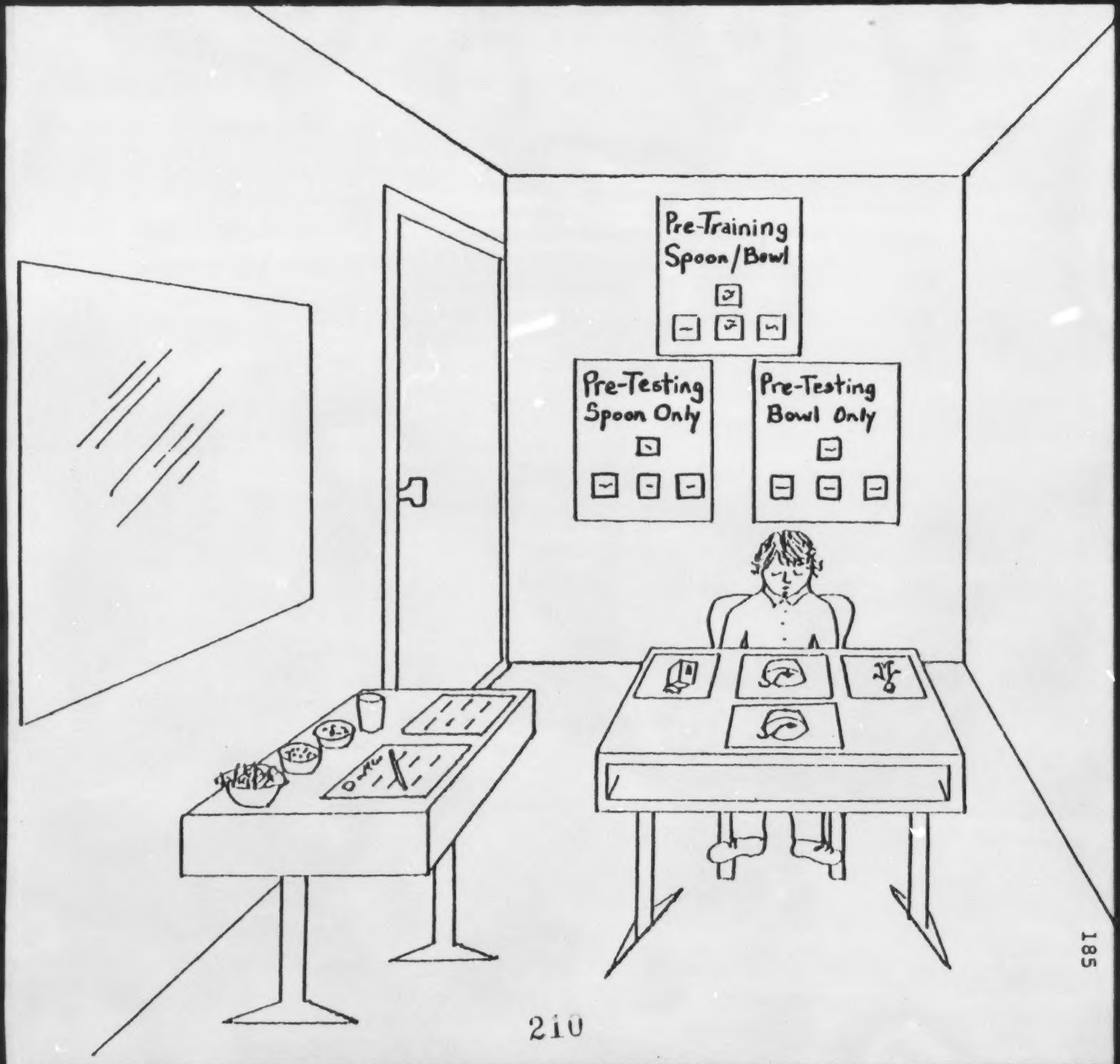
Configuration of stimuli for foot/shoe test trials:
50% of trials with "shoe-only" component, 50% with "foot-only" component



Configuration of stimuli for crayon/drawing-paper test trials:
50% of trials with "drawing-paper-only" component, 50% with "crayon-only" component

Appendix C

Sketch of the instructional setting


Pre-Training
Spoon/Bowl
Pre-Testing
Spoon Only
Pre-Testing
Bowl Only

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Appendix D

Sample data collection forms

VOST Data Collection Form: Spoon/Bowl Task

Comparison A: Spoon Distractor 1: fork

Comparison B: Bowl Distractor 2: plate

Trial #	N/S posit'n	C	P	I	A	B	Contrast Item
1	R						
2	L				spoon		
3	R						
4	M					bowl	
5	L						
6	L						
7	R				spoon		
8	M						
9	L						
10	R					bowl	
11	M						
12	L						
13	M						
14	L					bowl	
15	R						
16	M				spoon		
17	M						
18	L						
19	R						
20	L					bowl	
21	R						
22	M						
23	L						
24	M				spoon		
25	R						
26	R					bowl	
27	M						
28	R						
29	L				spoon		
30	R				spoon		
31	M						
32	L						
33	L				spoon		
34	R						
35	M					bowl	
36	R						
37	L						
38	M					bowl	
39	L						
40	M				spoon		
41	L						
42	R				spoon		
43	M						
44	M						
45	L					bowl	
46	R						
47	L						
48	R					bowl	
49	M						
50	L						
51	M						
52	L				spoon		
53	R						
54	M						

Pupil: _____ Day: _____ Date: _____

Trainer: _____ Start time: _____ Session length: _____

Spoon: _____/18 Bowl: _____/18

VOST Data Collection Form: Foot/Shoe Task

Comparison A: Foot Distractor 1: hand

Comparison B: Shoe Distractor 2: mitten

Trial #	A/B	posit'n C	P	I	A	B	Contrast Item
1	R						
2	L				foot		
3	R						
4	M					shoe	
5	L						
6	L						
7	R				foot		
8	M						
9	L						
10	R					shoe	
11	M						
12	L						
13	M						
14	L					shoe	
15	R						
16	M				foot		
17	M						
18	L						
19	R						
20	L					shoe	
21	R						
22	M						
23	L						
24	M				foot		
25	R						
26	R					shoe	
27	M						
28	R						
29	L				foot		
30	R				foot		
31	M						
32	L						
33	L				foot		
34	R						
35	M					shoe	
36	R						
37	L						
38	M					shoe	
39	L						
40	M				foot		
41	L						
42	R				foot		
43	M						
44	M						
45	L					shoe	
46	R						
47	L						
48	R					shoe	
49	M						
50	L						
51	M						
52	L				foot		
53	R						
54	M						

Pupil: _____ Day: _____ Date: _____

Trainer: _____ Start time: _____ Session length: _____

Foot: _____ / 18 Shoe: _____ / 18

VOST Data Collection Form: Crayon/Drawing paper Task

Comparison A: Crayon Distractor 1: Pencil

Comparison B: Drawing paper Distractor 2: Writing paper

Trial #	N/B	position C	P	I	A	B	Contrast Item	Trial #	N/B	position C	P	I	A	B	Contrast Item
1	R							28	R						
2	L				crayon			29	L				crayon		
3	R							30	R				crayon		
4	M					draw		31	M						
5	L							32	L						
6	L							33	L				crayon		
7	R				crayon			34	R						
8	M							35	M					draw	
9	L							36	R						
10	R					draw		37	L						
11	M							38	M					draw	
12	L							39	L						
13	M							40	M				crayon		
14	L					draw		41	L						
15	R							42	R				crayon		
16	M				crayon			43	M						
17	M							44	M						
18	L							45	L					draw	
19	R							46	R						
20	L					draw		47	L						
21	R							48	R					draw	
22	M							49	M						
23	L							50	L						
24	M				crayon			51	M						
25	R							52	L				crayon		
26	R					draw		53	R						
27	M							54	M						

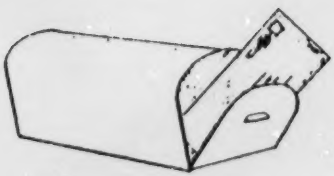
Pupil: _____ Day: _____ Date: _____

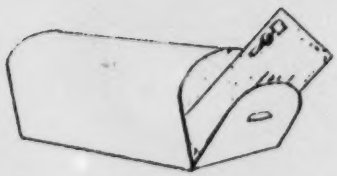
Trainer: _____ Start time: _____ Session length: _____

Crayon: _____/18 Drawing paper: _____/18

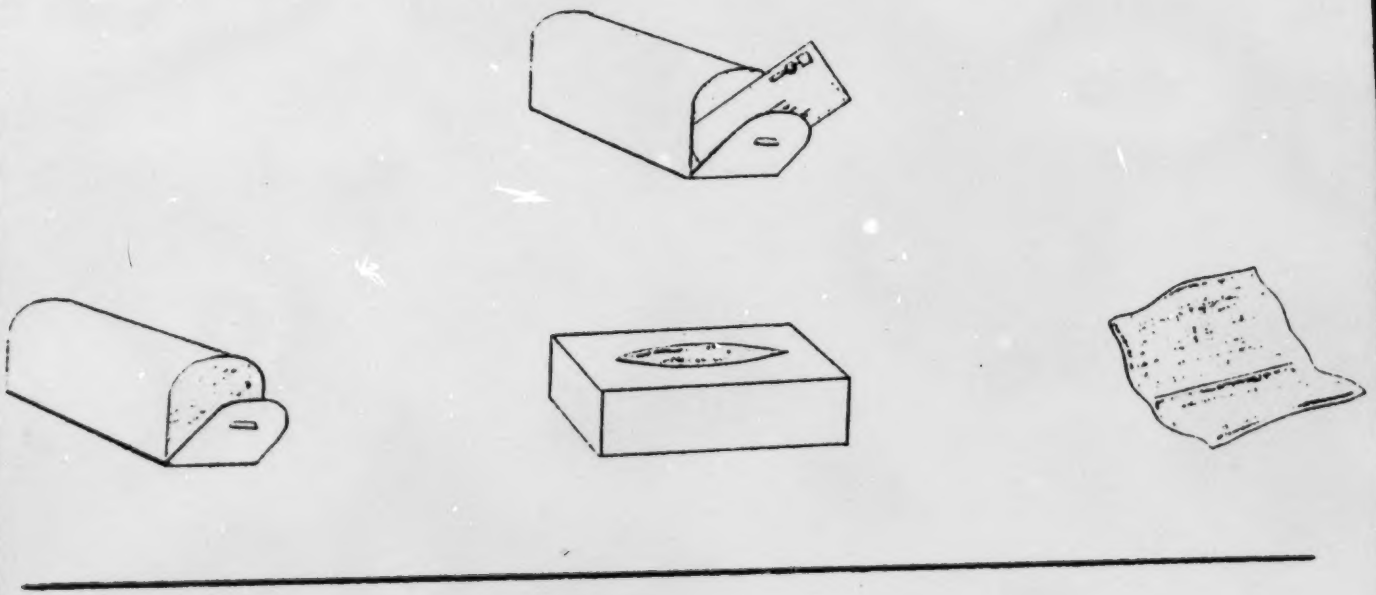
Appendix E

Configuration of stimulus generalization probes

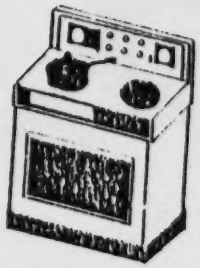




Configuration of training stimuli for the letter/mailbox generalization task probe



Configuration of stimuli for the letter/mailbox generalization test



Configuration of training stimuli for the basket/basketball generalization tast probe

Appendix F

Behavioral objectives and logical task analyses for teaching three functional object-use skills

Behavioral Objective and Logical Task Analysis for "Functional object-use" Intervention

Instructional Objective: (Functional use of spoon & bowl) Pupil: _____

Behavioral Objective: Given a spoon, bowl, mixture, and the task request, "Let's use the spoon," S will use the spoon to transfer sand, pebbles, and a soft-drink ingredient from one bowl to another, on 100% of 100 trials, with or without prompting.

Materials: (1) Functional objects Spoon, Bowl, Mixture (sand, pebbles, soft-drink mix)

(2) Distractor objects Doll, Stove

(3) Other: _____

TASK ANALYSIS for Spoon/Bowl

1. Grasp spoon by handle, rightside up
2. Put spoon in 'mixture' bowl
3. Fill spoon with mixture
4. Lift filled spoon
5. Transfer filled spoon to 'empty' bowl
6. Put filled spoon into 'empty' bowl
7. Deposit mixture in 'empty'bowl
8. Replace empty spoon on table near bowls

9220

Training criteria:

1st session: 70 trials, using prompts as required

2nd session: 10 warmup trials followed by posttesting

3rd session: 10 warmup trials followed by posttesting

4th session: 10 warmup trials followed by posttesting

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Behavioral Objective and Logical Task Analysis for "Functional object-use" Intervention

Instructional Objective: (Functional use of foot & shoe) Pupil: _____

Behavioral Objective: Given a doll's foot, doll's shoe, and the task request, "Let's put the foot in the shoe," S will correctly place the foot into the shoe on 100% of 100 trials, with or without prompting.

Materials: (1) Functional objects Left & Right doll's foot, Left & Right doll's shoe (without laces)

(2) Distractor objects Doll, Stove

(3) Other: _____

TASK ANALYSIS for Foot/Shoe

1. Grasp foot in one hand, shoe in the other
2. Lift foot from table and insert it into shoe
3. Balance foot-in-shoe on table in upright position
4. Remove foot from shoe
5. Place both the foot & shoe on the table
6. Repeat sequence with other foot/shoe
7. _____
8. _____
9. _____

Training criteria:

1st session: 70 trials, using prompts as required

2nd session: 10 warmup trials followed by posttesting

3rd session: 10 warmup trials followed by posttesting

4th session: 10 warmup trials followed by posttesting

Behavioral Objective and Logical Task Analysis for "Functional object-use" Intervention

Instructional Objective: (Functional use of crayon & paper) Pupil: _____

Behavioral Objective: Given a red crayon, yellow drawing paper, and the task request, "Let's draw," S will mark the yellow paper with one or more strokes, with or without prompting, for 30 seconds on each of 100 trials.

Materials: (1) Functional objects Red crayon, Yellow drawing paper

(2) Distractor objects Doll, Stove

(3) Other: _____

TASK ANALYSIS for Crayon/Drawing paper

1. Grasp red crayon
2. Hold paper against tabletop with other hand
3. Pick up crayon and place on paper
4. Press crayon on paper to make red mark(s)
5. Lift crayon from paper
6. Place crayon back on table by drawing paper
7. _____
8. _____
9. _____

Training criteria:

1st session: 70 trials, using prompts as required

2nd session: 10 warmup trials followed by posttesting

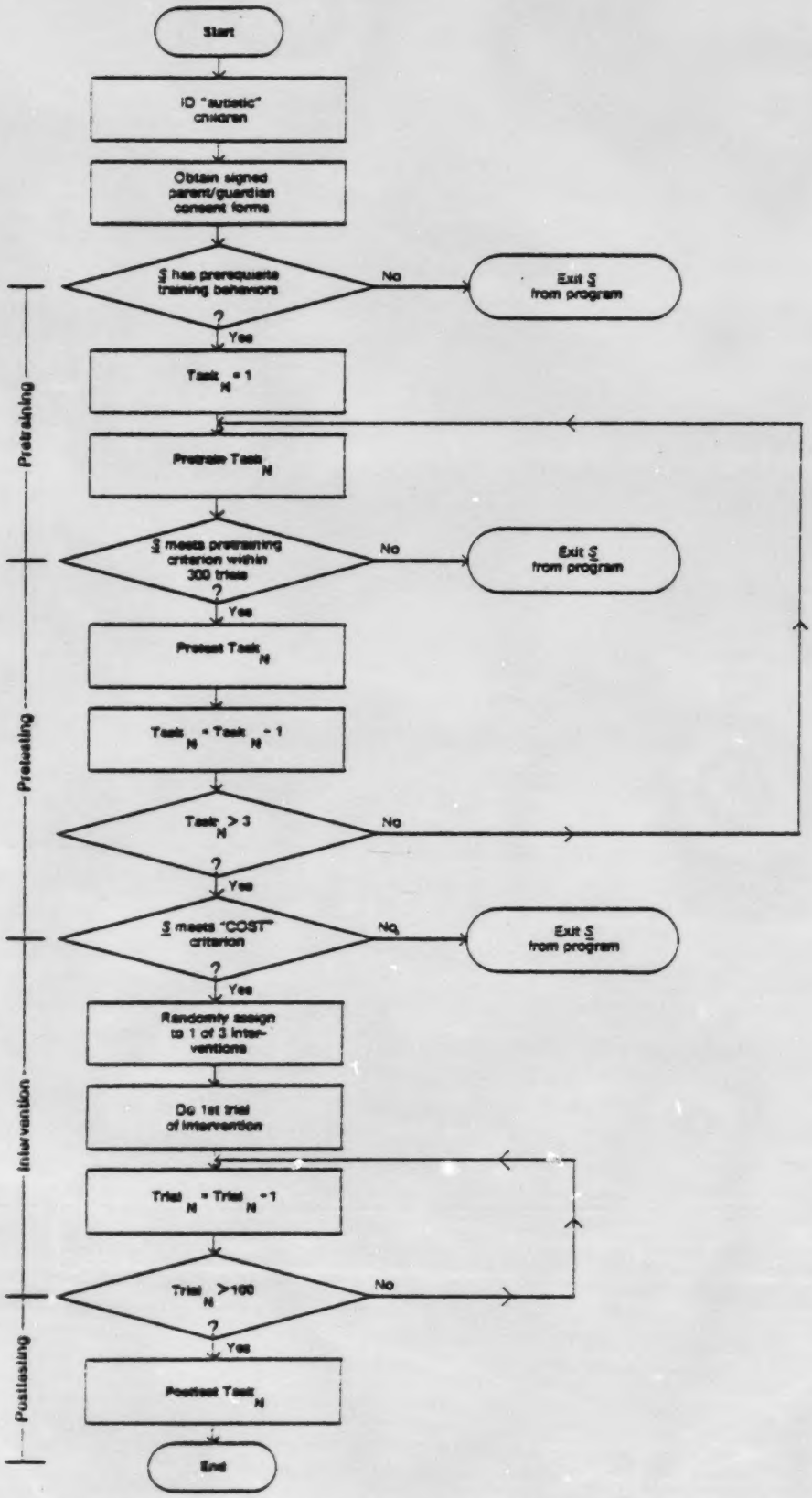
3rd session: 10 warmup trials followed by posttesting

4th session: 10 warmup trials followed by posttesting

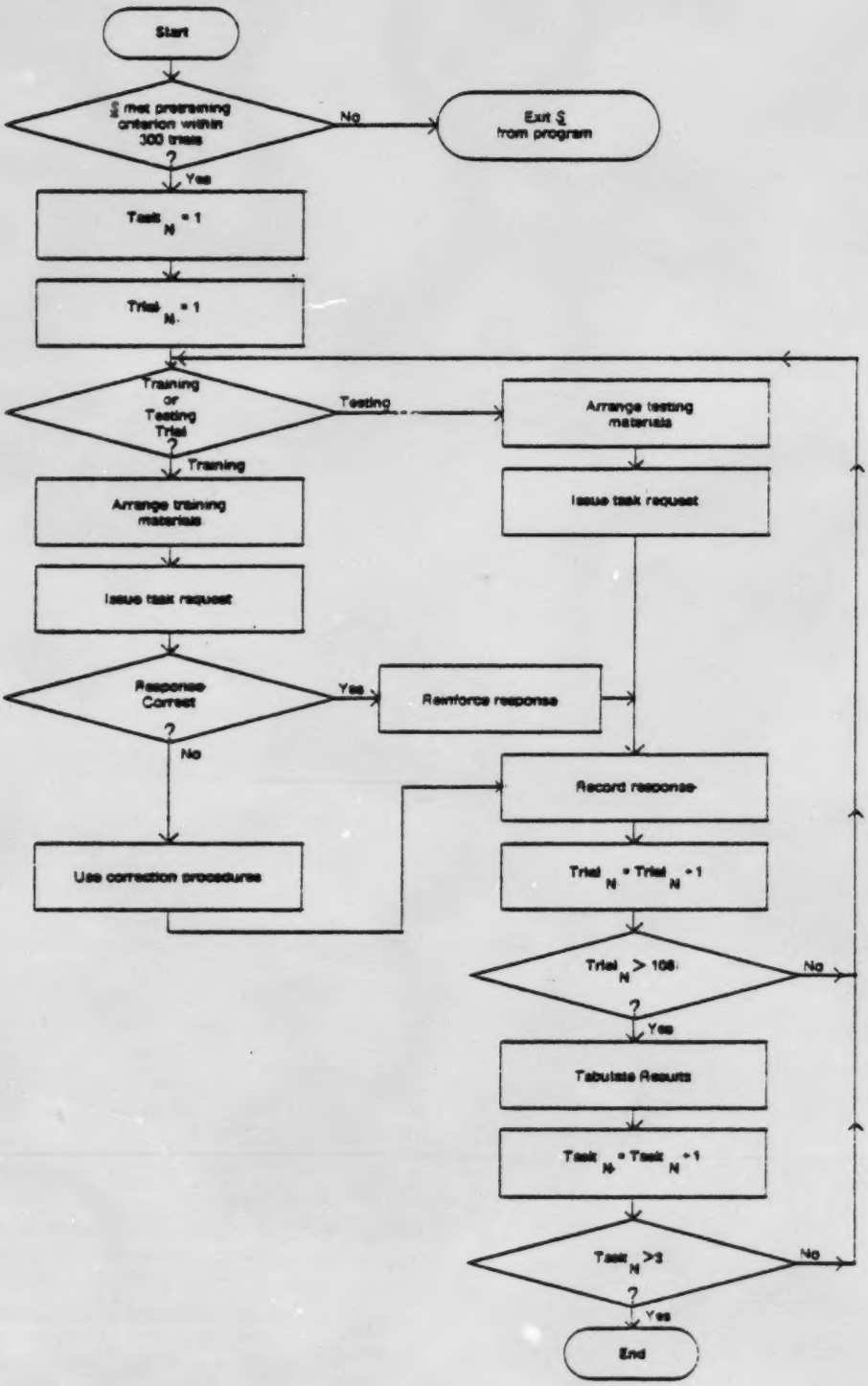
APPENDIX G

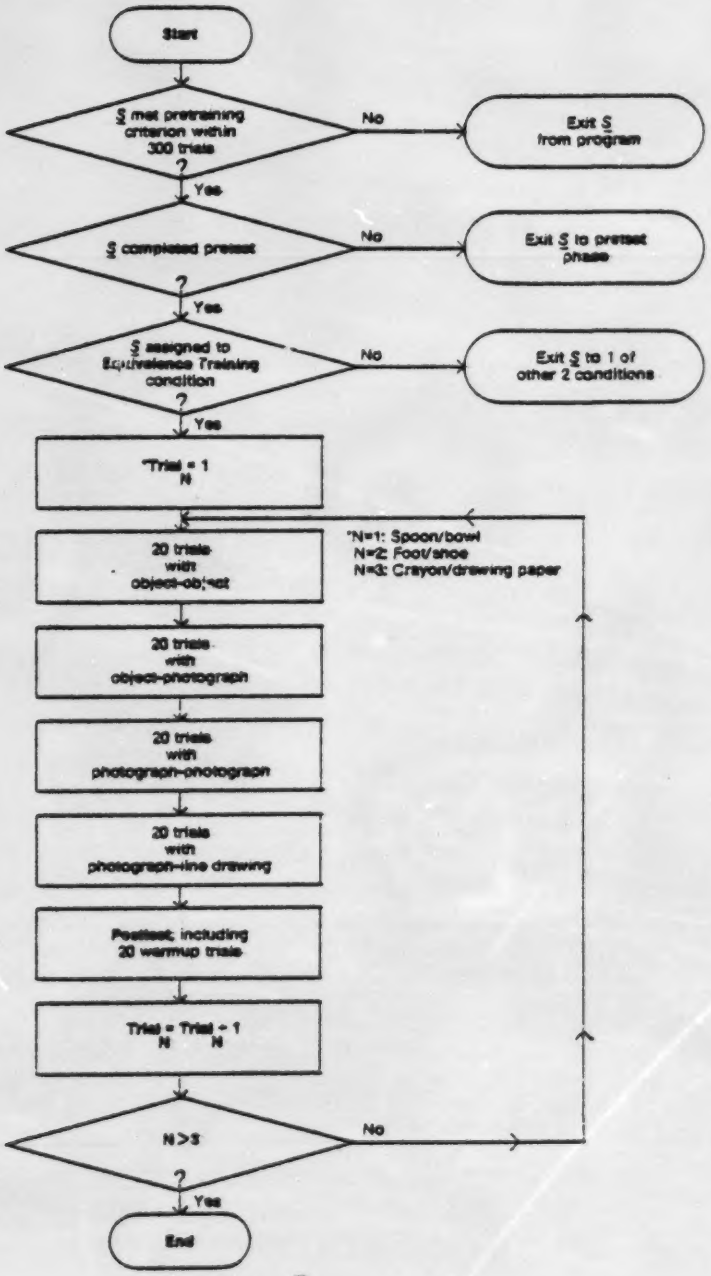
Flowcharts of the experimental procedures

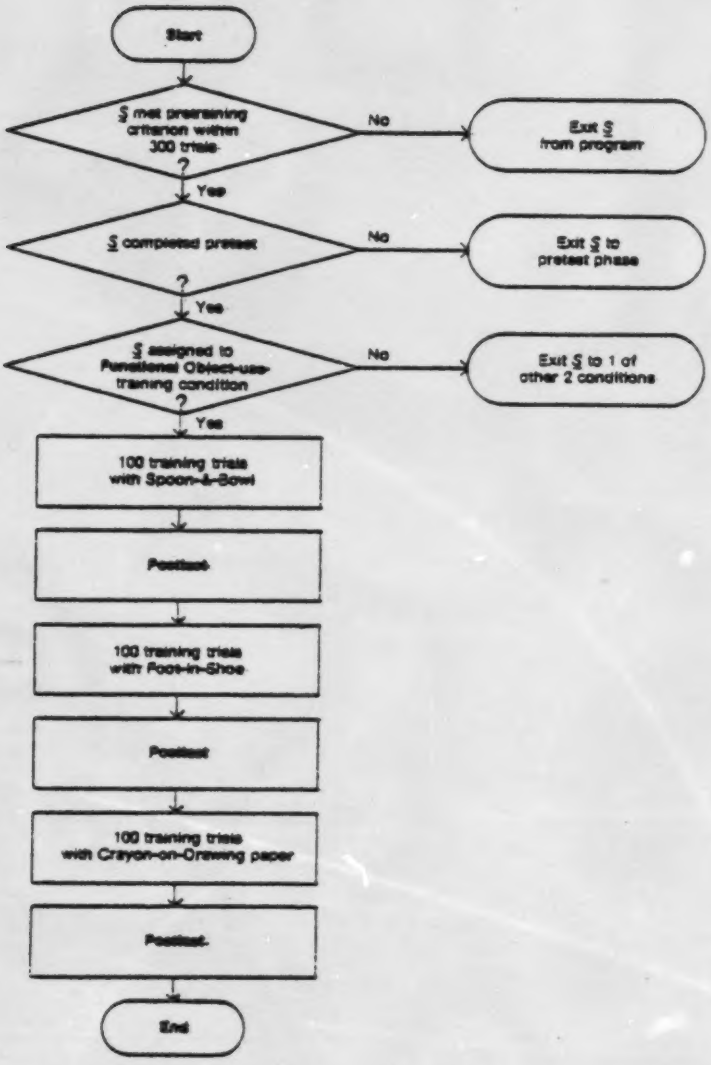
Flowchart of *VOST System

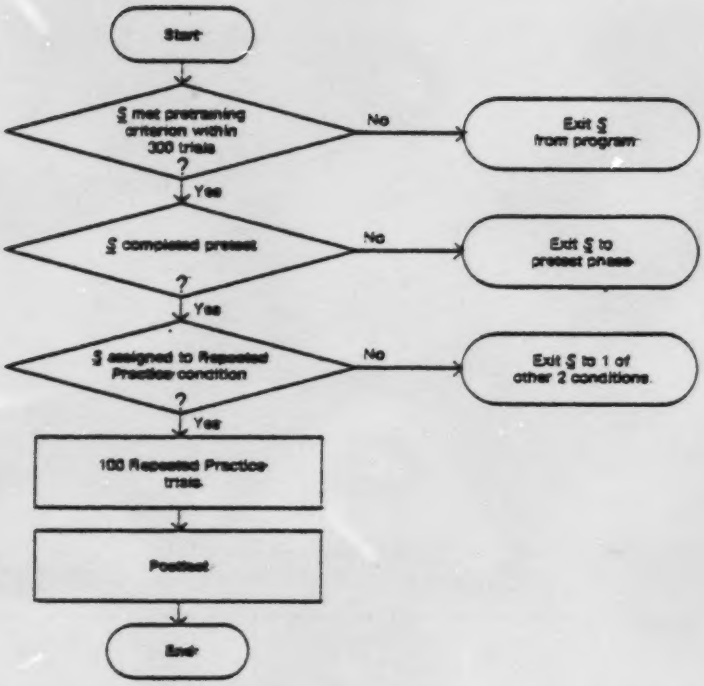


*VOST = Visual Overselectivity Testing/Training (System)


Start
S met prestraining criterion within 300 trials ?
No
Exit S from program
Yes
Task N = 1
Trial N = 1
Training or Testing Trial ?
Testing
Arrange testing materials
Issue task request
Training
Arrange training materials
Issue task request
Response Correct ?
Yes
Reinforce response
No
Use correction procedures
Record response
Trial N = Trial N + 1
Trial N > 108 ?
No
Yes
Tabulate Results
Task N = Task N + 1
Task N > 3 ?
No
Yes
End


Start
S met pretraining criterion within 300 trials
No
Exit S from program
Yes
S completed pretest
No
Exit S to pretest phase
Yes
S assigned to Equivalence Training condition
No
Exit S to 1 of other 2 conditions
Yes
*Trial = 1 N
20 trials with object-object
*N=1: Spoon/bowl
N=2: Foot/shoe
N=3: Crayon/drawing paper
20 trials with object-photograph
20 trials with photograph-photograph
20 trials with photograph-line drawing
Posttest, including 20 warmup trials
Trial = Trial + 1 N N
N>3
No
Yes
End


Start
S met preraining criterion within 300 trials
?
No
Exit S from program
Yes
S completed pretest
?
No
Exit S to pretest phase
Yes
S assigned to Functional Object-use training condition
?
No
Exit S to 1 of other 2 conditions
Yes
100 training trials with Spoon-&-Bowl
Posttest
100 training trials with Foot-in-Shoe
Posttest
100 training trials with Crayon-on-Drawing paper
Posttest
End


Start
S met pretraining criterion within 300 trials
?
No
Exit S from program
Yes
S completed pretest
?
No
Exit S to pretest phase
Yes
S assigned to Repeated Practice condition
?
No
Exit S to 1 of other 2 conditions
Yes
100 Repeated Practice trials
Posttest
End

APPENDIX H

Logical task analyses of overselectivity computations

Logical Task Analysis of *VOST Calculations

Task Analysis of Pretest Scores

1. To calculate a stimulus component score, count # of correct responses for each component of Test 1 of pretest. (Ex: 1 of 18 correct on spoon, 12 of 18 correct on bowl.) For the spoon/bowl compound, 1/18 is the "Component A" pretest score, 12/18 is the "Component B" pretest score.

2. Repeat step # 1 for each of the three test tasks. (Ex: 11 of 18 on foot, 7 of 18 on shoe; 12 of 18 on crayon, 18 of 18 correct on paper.) The three tasks thus produce 6 component pretest (and 6 component posttest) scores.

3. To determine a stimulus compound score, compare the two component scores for a given compound (e.g., spoon/bowl) and subtract the smaller numerator from the larger numerator. (Ex: 12/18 - 1/18 => 12-1=11.) The three test tasks thus produce three compound scores: 12-1=11 (spoon/bowl); 11-7=4 (foot/shoe); 18-12=6 (crayon/drawing paper).

4. To determine the COST (Conjunctive Overselectivity Test) Index, sum the three stimulus compound scores across the three test tasks. (Ex: 11 + 4 + 6 = 21.) The number "21" is the pretest COST index.

Task Analysis of Posttest Scores

1. Follow the same procedures used to calculate the three elements of the pretest COST Index to determine the posttest COST Index. (Ex: 13 of 18 on spoon, 16 of 18 on bowl; 11 of 18 on foot, 7 of 18 on shoe; 16 of 18 on crayon, 18 of 18 on paper.) Thus, (16-13) + (11-7) + (18-16) = 9. The number "9" is the summary posttest score (POST).

Task Analysis of Index of Visual Overselectivity

1. Subtract posttest overselectivity score from pretest overselectivity score. (Ex: 21-9 = 12.) The result (12) is the overselectivity index for that pupil. The larger the index # (12 vs -3, for example), the more "normal," the LESS overselective the pupil after intervention.

Task Analysis of Average Across-Task Test Results

1. Count the # of correct responses for each component of Test # 1 of pretest. (Ex: 1 of 18 correct on spoon; 12 of 18 correct on bowl.)

2. Repeat step # 1 for each of the 3 test tasks. Ex: 11 of 18 on foot, 7 of 18 on shoe; 12 of 18 on crayon, 18 of 18 correct on paper.

3. Distinguish between Component "A" (spoon, foot, crayon) and Component "B" (bowl, shoe, paper) stimuli. Sum the 3 Component "A" pretest scores (spoon=4, foot=12, crayon=13: 4+12+13 = 29). Sum the 3 Component "B" pretest scores (bowl=13, shoe=1, paper=13: 13+1+13 = 27).

4. Divide the sum of the 3 Component "A" pretest scores by 3: (4+12+13)/3 = 9.67). Divide the sum of the 3 Component "B" pretest scores by 3: (13+1+13)/3 = 9.00). The two resulting scores--9.66 and 9.00--are the average within-stimulus (Component "A" vs Component "B") pretest scores.

5. Repeat the above steps to determine the average across-task posttest scores (Component "A": spoon=2, foot=10, crayon=15; Component "B": bowl=12, shoe=6, paper=12). Summing across tasks (2+10+15)/3 = 9.00; (12+6+12)/3 = 10.00) results in two scores for the posttest -- 9.00 for Component "A" averages and 10.00 for Component "B".

Four scores thus obtain, 2 pretest scores (one for each component) and 2 posttest scores.

*VOST = Visual Overselectivity Testing/Training (System)

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